Bringing Therapy AT_HOME

On the Potential of Home Treatment as Alternative to Inpatient Treatment in Child and Adolescent Psychiatry

An Inaugural Dissertation Submitted to the Faculty of Human Sciences of the University of Bern for the Attainment of the Doctoral Degree

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Study 1

Graf, D., Sigrist, C., Boege, I., Cavelti, M., Koenig, J., & Kaess, M. (2024). Effectiveness of home treatment in children and adolescents with psychiatric disorders-systematic review and meta-analysis. *BMC Medicine*, *22*(1), 241. https://doi.org/10.1186/s12916-024-03448-2

Study 2

Graf, D., Lerch, S., Böhnke, U., Reichl, C., Kindler, J., Koenig, J., & Kaess, M. (2021). Treatment outcome of an intensive psychiatric home treatment for children and adolescents: a non-randomized controlled pilot evaluation. *European Child and Adolescent Psychiatry*, *32*, 685–695. https://doi.org/10.1007/s00787-021-01919-y

Study 3

Graf, D., Lerch, S., Böhnke, U., Reichl, C., & Kaess, M. (under review). Comparison of the long-term outcome of home vs. inpatient treatment: 18-24 months follow-up of a non-randomized controlled trial.

ABSTRACT

In the current climate of global crises and strained mental health systems, home treatment (HT) in child and adolescent psychiatry offers an approach to meet the growing needs of young people experiencing mental disorders. Unlike traditional inpatient treatment (IT), where patients go to a clinic, in HT a multidisciplinary treatment team brings the clinic to the patient's home. This approach is based on the premise that the young patient's environment is often both part of the problem and part of a sustainable solution, emphasizing strong family and systemic involvement to prevent relapse. Despite broad interest in HT for the potential to facilitate access to mental healthcare and enhance the stability of treatment effects, evidence of its effectiveness in child and adolescent psychiatry remains limited. Accordingly, this thesis aimed at a comprehensive evaluation of HT as an alternative to IT, presented across three studies. The first study provides a systematic review and meta-analytic synthesis of previous clinical trials on the topic. Both superiority and non-inferiority meta-analyses found no significant differences between HT and IT in improving the primary outcomes of psychosocial functioning and psychopathology. Studies 2 and 3 evaluated the clinical outcomes of a HT program piloted at the University Hospital of Child and Adolescent Psychiatry and Psychotherapy in Bern, Switzerland, considering both immediate (Study 2) and long-term (Study 3) treatment outcomes. Regarding the direct treatment course, no significant differences in psychopathological improvement were observed between HT and IT. However, follow-up outcomes showed greater stability in treatment effects for the HT group, with significantly better functional and psychopathological outcomes 21 months after discharge. Overall, the three studies provide macro- and micro-level evidence suggesting that HT represents an equally effective and potentially more sustainable alternative to IT for children and adolescents with mental disorders. Current methodological limitations are discussed, and implications for future research are outlined.

CONTENTS

1 INTRODUCTION & RELEVANCE

The presentation of prevalence rates of psychiatric disorders in children and adolescents has been used in numerous theses to highlight the pressing need for effective interventions in this field. However, rising incidence rates regularly provide updated figures for new introductions, with an estimated global prevalence rate of nearly 14% in 2024 (Kieling et al., 2024). This trend also affects German-speaking countries: To illustrate, a thesis written in 2012 would have reported a one-year prevalence of 22.9% among 11-13-year-olds in Germany, whereas the prevalence in 2022 was 27.4%, representing a relative increase of +19.3% (Thom et al., 2024). Among individuals aged 14-17 years, the relative increase was +25.9%, from 20.1% in 2012 to 25.3% in 2022. With these statistics in mind, it is not surprising that most psychiatric disorders have their onset during childhood and adolescence, with 50-60% of disorders emerging before the age of 18 and a peak onset age of 14.5 years (Caspi et al., 2020; Solmi et al., 2022). The burden of mental disorders is considerable, as reflected in an estimation by Gore et al. (2011) that the top ten leading causes of disease burden among 15-19-year-olds include six that are related to mental and substance use disorders (with depressive disorders and schizophrenia topping the ranking). Consistently, mental disorders have become the primary cause of non-fatal disability among children and adolescents, accounting for approximately 20% of years lived with disability (Kieling et al., 2024). Of course, these elevated proportions are not only indicative of a negative development, as they partially reflect substantial improvements in healthcare, with a global decline in child mortality and a reduction in the burden of somatic disease. However, mental health has deteriorated at the same rate.

While this trend has been observed for well over the past five years, the onset of the global COVID-19 pandemic in 2020 has posed particular challenges to the mental well-being of many young people. Although the impact of the pandemic on youth mental health is complex and not yet fully understood (Koenig et al., 2021), most studies report a deterioration across countries, particularly in relation to affective and anxiety disorders (Racine et al., 2021; Thorisdottir et al., 2021), self-harm (Madigan et al., 2023), and eating disorders (Trafford et al., 2023). Concurrently, the pandemic has raised awareness on this situation (McGorry et al., 2024), adding to the increased use of professional mental health services which resulted in prolonged boarding time before inpatient admission (Overhage et al., 2023). In Switzerland, 19,532 individuals aged 10 to 24 were hospitalized due to a psychiatric condition, which represents an increase of 22.7% compared to the average of 15,919 hospitalizations in the pre-pandemic years of 2018/2019 (Bundesamt für Statistik [BFS], 2022).

The consequence of this growing demand for mental healthcare is an urgent need for treatment options that are both effective and can be rapidly implemented and scaled. For children and adolescents with serious mental disorders and an indication for hospitalization, the current gold standard in Switzerland and many other countries is inpatient treatment (IT) in a psychiatric clinic (Green et al., 2007). IT provides a structured environment with multidisciplinary staff and an intense focus on patients presenting with severe psychiatric disorders. The round-the-clock care in a controlled setting allows for close monitoring of treatment progress, simultaneous use of multiple therapeutic interventions, and a clear daily structure, which can help promote a sense of continuity and security. In addition, patients often attend specialized inpatient schools during their stay to prevent disruption of their educational progress. Interacting with peers experiencing similar challenges can help build resilience and provide a sense of shared experience. Moreover, removing the child from a potentially problematic home environment also presents the opportunity to avert immediate risks to the patient and the recovery process and is sometimes perceived as relief for both the family and the child, which in turn can facilitate recovery (based on Reimer, 1983).

However, IT has been associated with several caveats and disadvantages. From a societal perspective, IT is a costly endeavor, requiring substantial infrastructure, accommodation, and 24/7 staffing (Hayes et al., 2018), which makes it less accessible and potentially unsustainable for health systems facing high demand and/or few resources. From an individual perspective, admission to an inpatient facility often involves considerable emotional and psychological distress, intensifying an already stressful situation and potentially compromising family relationships due to the disruption of the family system (Weller et al., 2015). Additionally, the institutional nature of IT can lead to stigmatization (Kaushik et al., 2016) and is sometimes perceived as coercive, thus undermining the therapeutic alliance between the patient and the treatment team (Guarda et al., 2007). Moreover, while peer interaction in IT settings can promote adaptive coping strategies, in some cases it may foster iatrogenic effects due to maladaptive behaviors being copied or reinforced by others (Wilmshurst, 2002). For instance, IT has been associated with an increased risk of non-suicidal self-injury in some adolescents (Reichl et al., 2023). Furthermore, although the inpatient stay can provide temporary relief, this can result in the so-called *holiday effect*, whereby the symptoms that necessitated treatment are less apparent in the structured and controlled environment of the clinic without contextual factors (Reimer, 1983; based on Beckmann et al., 1978). This increases the risk of a neglect of the underlying issues, such as a problematic family system, while emphasizing reduction of symptoms, which then resurface upon discharge (Reimer, 1983; Schmidt et al., 2006). Underscoring this jeopardy,

Herpertz-Dahlmann et al. (2020, p. 428) noted that "several patients and their parents [in their study] complained that the transition from hospital to home […] was too difficult to manage and that they did not feel prepared." This is particularly concerning when children return to an environment that remains unsecure or unsupportive, as reflected in high rehospitalization rates of up to 32% in adolescents following IT (Brinkmeyer et al., 2016; Bruns & Burchard, 2000). In light of these challenges, McGorry and colleagues (2024) argue in a recent Lancet Psychiatry Commission that the primary issue with youth mental healthcare is not inadequate access to IT, but the need to assemble modern systems of community-based care. Key elements of youth mental healthcare proposed by the authors include the "use mobile outreach and detection strategies […, to] draw on family engagement and support, including family peer workers, [and to] create seamless transitions into and out of services" (McGorry et al., 2024, p. 744). Concurrently, several population-based studies on the global mental health care situation have repeatedly called for more targeted intervention policies and evidence-based interventions to improve treatment rates (e.g., Wang et al., 2023). With this in mind, Home Treatment (HT) in child and adolescent psychiatry has been identified as a valuable addition to the mental health system.

2 Home Treatment in Child and Adolescent Psychiatry

HT in child and adolescent psychiatry relies on the assumption that sustained symptom change and positive development are best supported by changes in the young person's family and community environment (Woolston et al., 1998). Therefore, patients do not come to a professional health care facility, but remain – nomen est omen – at home, where they are visited by the treatment team (Berhe et al., 2005; Weinmann et al., 2019). However, it is challenging to describe what HT is beyond this key feature, as the term has often been (and still is) used as an umbrella term for treatment modalities delivered in a home-based setting, regardless of the scope of intensity, treatment team, or target population. Often this also subsumes different services such as Home-Based Crisis Intervention (HBCI, Evans & Boothroyd, 1997), Supported Discharge Service (SDS, Ougrin et al., 2018), Multisystemic Therapy (MST, Henggeler et al., 1999), and others (Burns et al., 2001). Therefore, there have been several approaches to disentangling the different terms. Recently, an expert opinion by a group of child and adolescent mental health clinicians, researchers, and academics around Dennis Ougrin proposed an agreed minimum set of requirements for what they introduced as Intensive Community Care Services (ICCS, Keiller et al., 2023). The group defined ICCS as "psychiatric treatment that is provided,

at a high frequency, primarily outside of hospital" (Keiller et al., 2023, p. 4) and included guidelines for organizational boundaries, human resources, nature and scope of services, and a consistent monitoring process. Taking a different approach, the German Association for Psychiatry, Psychotherapy and Psychosomatics (DGPPN) uses the terminology *Home Treatment* for a similar treatment, but additionally emphasizes that it "represents an alternative to standard inpatient treatment. The latter should be shortened or avoided by acute treatment in the home environment" (translated from the S3-Leitlinie Psychosoziale Therapien bei schweren psychischen Erkrankungen; 2019, p. 104). In the present work, the term HT follows the DGPPN-definition as intensive treatment in the home environment for patients in need of psychiatric treatment in acute phases of illness. The treatment is provided by specially trained, multi-professional, mobile treatment teams that provide care 24 hours a day, seven days a week, and aims to completely replace or shorten a hospital stay, i.e., to be equivalent to IT.

A unifying factor for all HT approaches is the idea of involving the family system and other environmental factors intensively in the treatment of children and adolescents with psychiatric disorders (Green & Worrall-Davies, 2008). This is done not only for legal reasons, but also because it offers the possibility of improving the effectiveness of therapy in several aspects. On the one hand, entering the familiar environment allows for a more holistic assessment of the presenting situation and the systems involved than in the clinic. Thus, problems can be observed and addressed in the natural context where they occur, thus reducing the risk of a holiday effect during treatment (Hodges & Blythe, 1992). On the other hand, the family and the broader system represent not only stressors and potential problems, but also possible resources that can be drawn upon and strengthened during treatment. By closely involving parents in treatment, they can be empowered as co-therapists who remain involved in the patient's daily life after discharge. The same applies to other important relatives and key figures such as teachers, peers, etc., who may be part of the problem, but also of a long-term and stable solution. Interventions developed together can be directly transferred to daily life and evaluated. Possible barriers to implementation can be identified and the intervention strategy modified without delay. Moreover, keeping the young patient in the family may help prevent possible iatrogenic effects associated with hospitalization, which can also be perceived as coercive (Herpertz-Dahlmann et al., 2020) and reduces the risk of adopting maladaptive strategies learned from peers (Wilmshurst, 2002). In addition, the non-institutional nature of HT may help to reduce stigma and negative attitudes, which have been identified as a major barrier to young individuals seeking help when facing mental issues (Baldofski et al., 2024; Cavelti et al., 2024; Radez et al., 2021). At a macro-level, a psychiatric treatment team that has close contact with the community, rather than taking

individuals from the community to the clinic, may promote a general destigmatization of psychiatry in society. From the same societal perspective, the reduction of treatment costs is another aspect of particular importance (Schmidt et al., 1998). Reducing the clinical infrastructure from hospital buildings to a transport fleet, and hospital staff from 24/7 supervision to core members of the treatment team allows resources to be relocated (Boege et al., 2015; Ougrin et al., 2018; Sheidow et al., 2004). This could help meet the increasing demand for professional mental healthcare detailed above with limited resources, and a total of only 2% of health budgets devoted to mental healthcare on a global level (Knapp & Wong, 2020).

In summary, compared to IT, HT may help to reduce barriers to professional mental healthcare by reducing stigma, to achieve better transfer of treatment gains to everyday life after discharge and thus greater stability of treatment effects, and to scale up capacity for intensive treatment due to lower treatment costs.

2A Theoretical Framework

To understand the rational and effectiveness of HT, several models and theories are relevant. They provide a biopsychosocial framework which shifts from a purely medical model of mental disorders that is centered on the individual, to a biopsychosocial model that emphasizes the involvement of the entire system in the therapeutic process. Firstly, although the importance of the family and others in the etiology of a presenting disorder is widely acknowledged and considered in IT and most other therapy settings, *Family Systems Theory* is particularly relevant to HT. This theory views the patient and symptoms in the context of the family, i.e., an interconnected system in which changes in one member affect the entire unit, and emphasizes the importance of family dynamics and relationships in individual problems (Minuchin, 1974). According to family systems theory, patterns within a family operate in a circular rather than linear manner, meaning that actions and reactions between family members are complex and bidirectional. Understanding these dynamics is critical to HT because interventions often need to involve multiple family members to promote sustainable change. Knowledge of family subsystems, boundaries, and rules helps in family diagnosis and developing a shared understanding of the presenting issues, but also in tailoring interventions to each unique family situation, promoting positive interactions, and reducing dysfunction (Petermann, 2013, Chapter 44).

Another important theory in this context is the *Ecological Theory of Human Development*, proposed by Bronfenbrenner (Bronfenbrenner, 1979; as described in Wasik & Bryant, 2001, Chapter 2), which expands the view of the individual within the family to include the broader

environment. This theory posits that individuals exist within multiple layers of influence, from the immediate family to the larger community and society. It emphasizes how factors such as neighborhoods, schools, and government policies impact family functioning, and has been particularly influential in HT programs as it underscores the need – but also the chance – to consider social and community variables when planning interventions. By recognizing the importance of social support networks and the family's interaction with its environment, HT aims to create change not only within the individual, but also within the broader context in which they live.

Cognitive/Behavioral Theories focus on the role of behavior change and cognitive processes in the management of problems. In the context of HT, interventions often target both the child's and the family's behavior with the goal of establishing new, more adaptive patterns. Techniques such as modeling, reinforcement plans, prompting, and cognitive restructuring can be used to help patients and families develop more effective coping strategies. For example, the treatment team might help parents identify and change beliefs that and interfere with effective parenting or assist children in learning new coping mechanisms.

Lastly, a unique aspect of HT is the expansion of the therapeutic relationship between therapist and patient from a *Dyadic to a Triadic Model*. According to Reimer (1983; based on Tharp & Wetzel, 1975), long-term change is most often achieved not through direct, punctual interaction between therapist and patient, but through the mediating influence of a third person, i.e., the parents. Therefore, they take a central position as co-therapists between the treatment team and the patient, implementing and realizing the jointly designed interventions in everyday life, even when the treatment team is not present.

2B What Happened so Far?

The idea of home visiting is not new to child and adolescent psychiatry. Wasik and Bryant (2001) describe early precursors rooting in informal care provided by relatives, neighbors, and community members. These approaches became more structured during the 19th and 20th centuries, largely in response to societal challenges such as poverty, illness, and the need for childcare. In the late 19th century, figures such as Florence Nightingale pioneered the integration of professional nursing into home care, emphasizing the growing recognition of the importance of maintaining the integrity of the family rather than institutionalizing children. In the mid-20th century, the deinstitutionalization movement, which aimed to reduce reliance on institutional care, further strengthened the role of home-based services. In the literature, the first large-scale

studies on inpatient-equivalent HT date back to the 1960s (Pasamanick et al., 1964) in the treatment of schizophrenia in adult psychiatry. In child and adolescent psychiatry, first studies were reported in the 1980s in North America (Winsberg et al., 1980) and Europe (Reimer, 1983), with further clinical trials following over the last four decades. With the growing interest in this treatment modality, several endeavors have been undertaken to synthesize the existing evidence on its clinical effectiveness, resulting in an abundance of (systematic) review articles (e.g., Catty et al., 2002; Clisu et al., 2022; Kwok et al., 2016) that almost equals the number of underlying original studies. Although many of these reviews differ slightly in terms of inclusion criteria or specific treatment modality, most of them indicate that HT is a promising alternative to IT. However, these conclusions are limited by the small number of studies included, modest sample sizes, and lack of meta-analytic aggregation, as has been done previously for HT in adult psychiatry (including one Cochrane review; Murphy et al., 2015). Therefore, the aim of the first study presented in this thesis was to provide an updated review of the evidence to date on the effectiveness of HT as an alternative to IT in child and adolescent psychiatry, and to synthesize this evidence in a comprehensive meta-analysis.

Study 1

Systematic Review and Meta-Analysis

Appendix A

Graf, D., Sigrist, C., Boege, I., Cavelti, M., Koenig, J., & Kaess, M. (2024). Effectiveness of home treatment in children and adolescents with psychiatric disorders-systematic review and meta-analysis. *BMC Medicine*, *22*(1), 241. https://doi.org/10.1186/s12916-024-03448-2

The study protocol was pre-registered with PROSPERO (CRD42020177558; July 5, 2020). The underlying dataset and analysis code are available on the Open Science Framework (osf.io).

In this systematic review and meta-analysis, we conducted a search of four databases and included randomized and non-randomized controlled trials ([n]RCTs) published up to December 2023 that compared HT with an IT control group. HT programs had to meet the criteria detailed in Chapter 2; that is, be equivalent to IT. Our primary outcomes were psychosocial functioning and psychopathology, while secondary outcomes included treatment satisfaction, duration, cost, and readmission rates. We used group differences as indicator of effectiveness, expressed as standardized mean differences (SMD) in change scores between pre- and post-treatment and follow-up. We then performed three-level random-effects meta-analysis and meta-regression to analyze the data, focusing on both superiority and non-inferiority testing.

Of the 5,837 records identified, 30 studies from 13 non-overlapping samples met our inclusion criteria, contributing data from 1,795 individuals (mean age at baseline: 11.95 ± 2.33 years; 42.5% female). We found no significant differences between the two treatment modalities for our primary outcomes of postline psychopathology (forest plot in Figure 1, SMD = 0.01 [95% CI, -0.17 to 0.37], $p = 0.48$) and psychosocial functioning (forest plot in Figure 2, SMD = 0.02 [95% CI, -0.20 to 0.25], $p = 0.83$). Similar results were observed from follow-up data and all secondary outcomes. In addition, the non-inferiority analysis showed that HT was not inferior to IT for both primary outcomes. Meta-regression revealed better outcomes for HT in patient groups with higher baseline levels of psychopathology and when RCTs were analyzed separately. No significant moderators of psychosocial functioning were identified.

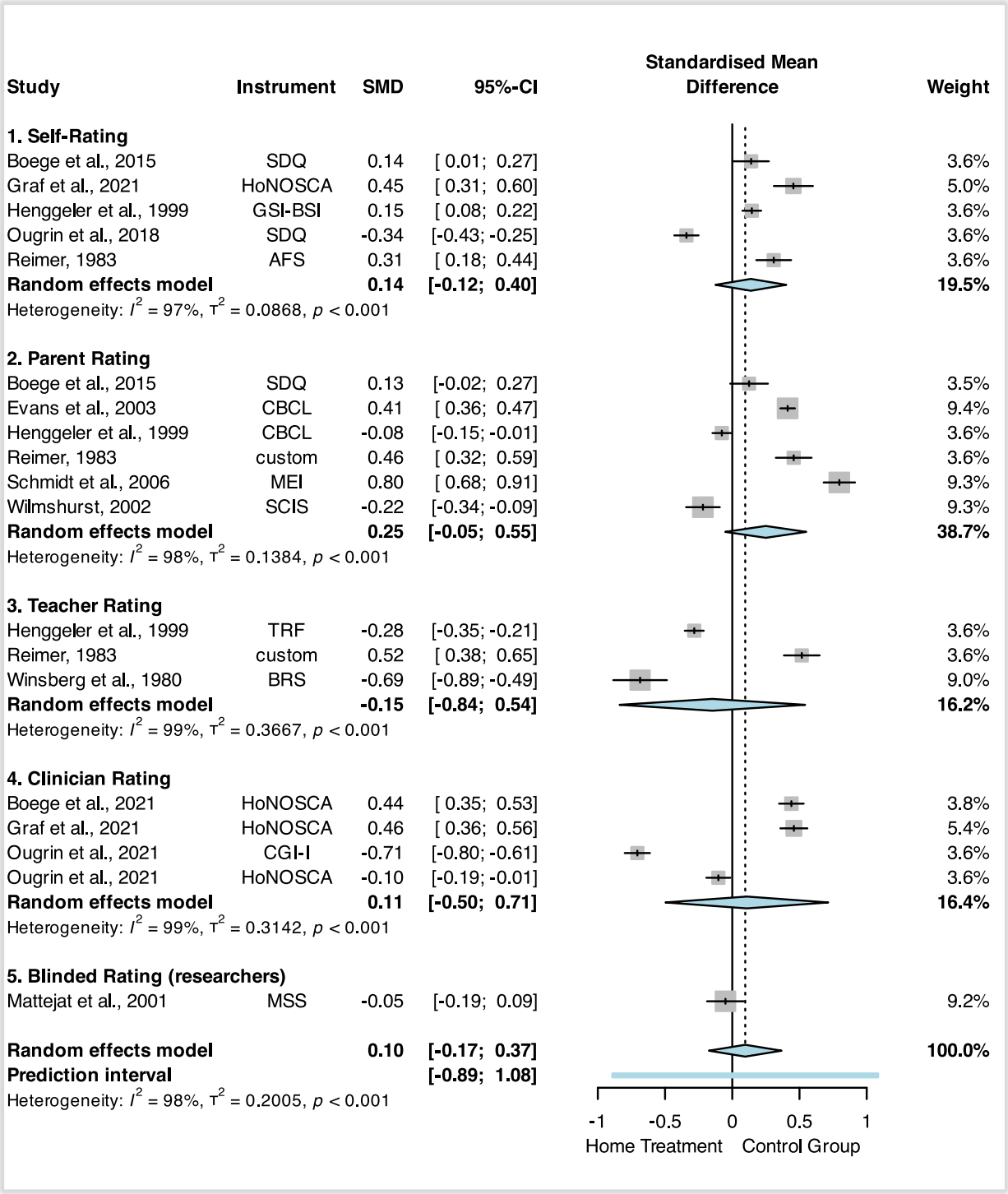

Figure 1 Differences in pre- to post-treatment effects in psychopathology. Negative values indicate greater effects for Home Treatment
SMD = standardized mean difference. A complete list of all abbreviations can be found in the original article in Appendix A

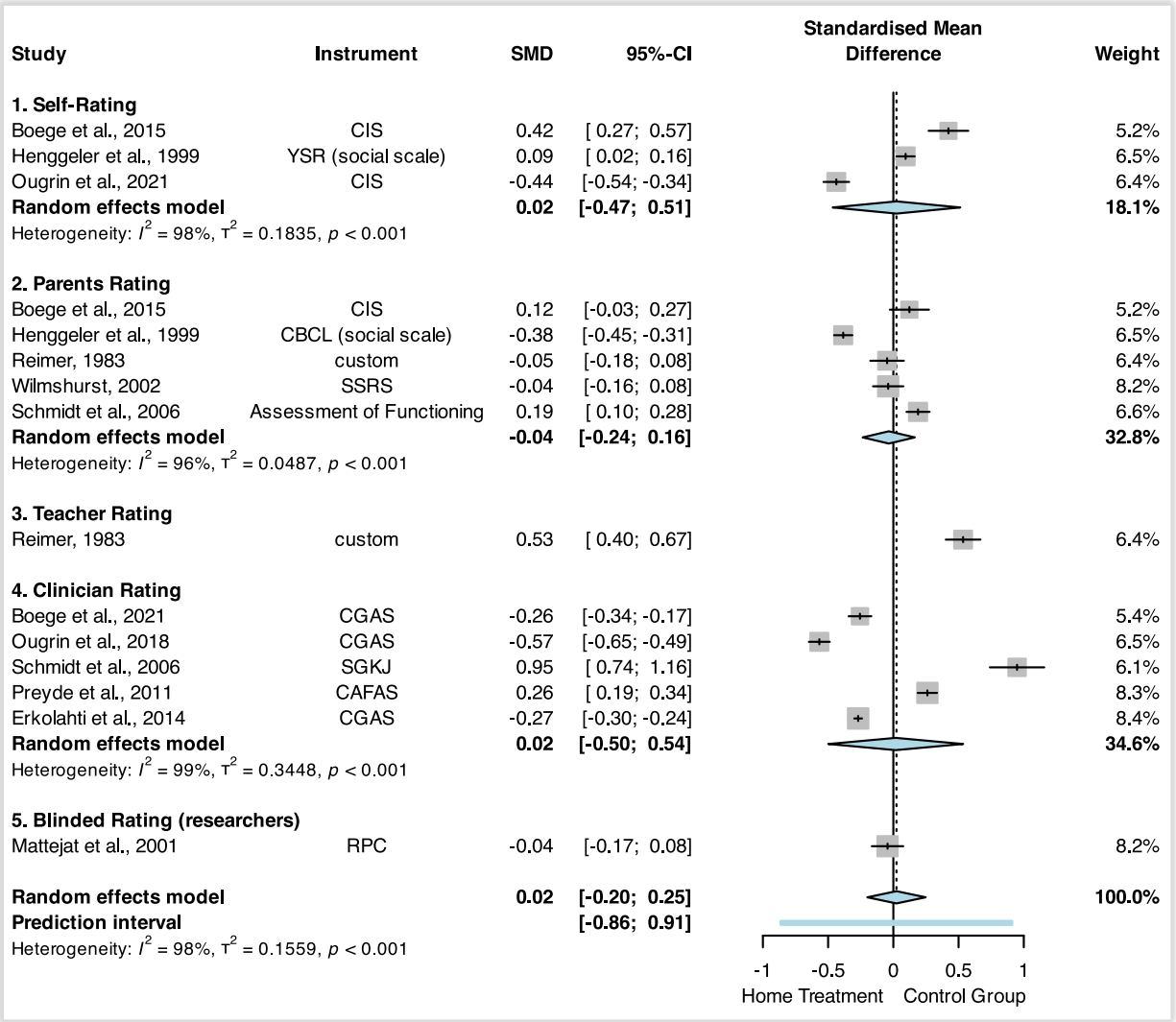

Figure 2 Differences in pre- to post-treatment effects in psychosocial functioning scores. Negative values indicate greater effects for Home Treatment
SMD = standardized mean difference. A complete list of all abbreviations can be found in the original article in Appendix A

In conclusion, the findings suggested that HT is not less effective than conventional IT in terms of both short-term and long-term effects. However, several limitations concerning both our methodology and the existing body of literature should be noted. These include a moderate-to-high risk of bias for most RCTs and all nRCTs and considerable statistical heterogeneity (all I^2 > 90%), reflecting the variation in treatment modalities, reported outcomes, and measures across the included studies. To address these limitations, we have derived from our findings several suggestions for improvements in future trials and better comparability of their results, which the interested reader might consult in Appendix A before starting their own trial.

3 AT_HOME

AUFSUCHENDE THERAPIE – ZU HAUSE, ORIGINELL, MOBIL, EFFEKTIV

Although the findings of the meta-analysis are promising, the heterogeneity of the studies, spanning four decades and six countries with different legal and financial frameworks, as well as varying IT quality, limits their generalizability to other healthcare systems. For example, only one of the included studies was conducted in Switzerland (which was our own study), where approaches to inpatient-equivalent HT have only been described in adult psychiatry (Baumann et al., 2023; Stulz et al., 2019). Interestingly, there have been treatment programs in child and adolescent psychiatry in Switzerland that included home visiting elements, such as MST (Rhiner et al., 2011) and family-based treatment (FBT, Pauli et al., 2022). However, these were tailored to patients with specific diagnoses and not intended as an alternative to inpatient treatment.

In the Canton of Bern, the AT_HOME project was implemented as part of a model project by the University Hospital of Child and Adolescent Psychiatry and Psychotherapy (CAP) in 2019, following a call from the government of Bern to develop and implement a home-based acute psychiatric care model.

3A Program Characteristics

AT_HOME is designed as station-equivalent HT for children and adolescents aged 6 to 17 with general psychiatric disorders. The program offers treatment for up to 10 patients who live in a stable housing situation within a 45-min catchment area of the CAP. Exclusion criteria are acute suicidality or child welfare hazards in the patient's household. Despite the program's name, "a stable housing situation" is not limited to the standard scenario of a patient living at home with his or her parents. Instead, treatment is also available when the patient is living in a residential facility, foster home, or other institution. Treatment is delivered by a multidisciplinary team consisting of nurses, social pedagogues, child and adolescent psychotherapists and psychiatrists, a school counselor (non-teaching) and one therapy dog. Patients in AT_HOME receive six visits a week (60-120 minutes) from a team member, supplemented by a phone call on weekends and a 24/7 crisis management hotline. Most treatment takes place outside the hospital, usually in the patient's home or, if appropriate, in other locations such as schools or workplaces. Once a month, all patients enrolled in the treatment meet at CAP Bern, allowing interchange between patients and families. During the course of treatment, each patient is assigned

a key contact person (*Bezugsperson*) and an individual therapist responsible for overseeing the treatment trajectory. Patients can continue attending their regular school or are supported in returning there, if they have been absent. In the event of an acute suicidal crisis, immediate admission to the CAP is available, with the HT team continuing to provide care for up to three days. The program is designed for a maximum treatment duration of three months, with the possibility of extending for one additional month if necessary.

3B Treatment Concept

In general, the treatment components in AT_HOME are closely related to those in IT, with the difference that they are implemented and practiced in the patient's home instead of in the clinic (this also includes physical examinations such as blood sampling or ECG). However, based on the theoretical framework in Chapter 2A, a number of practical guidelines can be drawn from the provision of HT in AT_HOME (Gehrig & Kaess, 2020; Wasik & Bryant, 2001).

- Family as a system: Because the family functions as an interconnected system, changes in one member can affect the entire family. AT_HOME engages key family members to promote positive interactions and systemic change. Individual family resources can be assessed, strengthened, and incorporated into treatment.
- Family in the context of the broader environment: AT_HOME assesses the individual systems relevant to a family and involves them in the treatment process, e.g., offering dialogue with teachers, extended family, friends, and peers. The treatment team can enter these broader systems if required, e.g., by accompanying a patient as part of school training. One key focus is the coordination of the transition to subsequent services such as outpatient treatment, a change of school, or any other measures needed to achieve a stable solution for both patient and family.
- Parents as co-therapists: Although a key contact person (Bezugsperson) and an individual therapist are assigned at the beginning of therapy, parents maintain their supervisory role throughout the treatment process. The parents can be empowered as co-therapists who remain involved in the patient's daily life after discharge.
- Collaborative relationships: Families are encouraged to actively participate in identifying needs and developing strategies. Shifting from the historical perspective that society and professionals know best what is good for the patient to empowering the family as experts on their own child helps to experience self-efficacy and build confidence in

helping their own child, but also to recognize their own responsibility and thus strengthen their commitment to therapy.

— Flexibility and responsiveness: AT_HOME is flexible to meet different family needs according to their individual situation. This may include providing direct support, coordinating additional services, mediating complex interactions between different systems, and adapting interventions without delay when barriers are encountered.
— Promotion of coping and problem-solving skills: During the therapy phase, AT_HOME focuses on enhancing the patient's and the family's ability to cope with current and future stressors. Evidence-based cognitive-behavioral interventions can be used for symptom-specific therapy, like dialectic behavioral therapy for adolescents (DBT-A). Ongoing practice, such as repeated exposition to frightening situations or family communication in stressful situations, is important.
— Generalization of skills: AT_HOME aims to enable families to apply learned skills to future situations, promoting long-term resilience and self-sufficiency.

3C Effectiveness

The AT_HOME program began clinical practice in May 2019. In 2021, we evaluated the initial outcomes of the pilot phase using clinic data collected as part of a regular quality assurance process, under the Swiss National Association for Quality Development in Hospitals and Clinics (ANQ). The pilot evaluation aimed to answer two main questions: (1) Was HT in AT_HOME sufficiently intensive for the treatment of children and adolescents with acute psychiatric disorders? (2) Were treatment effects more stable after discharge compared to IT?

For the first question, we anticipated that HT would not be less effective than IT during the immediate course of treatment, given the intensive care provided through daily visits by a multidisciplinary team, as reported in previous clinical trials. However, we did not expect HT to be more effective than IT, which would appear presumptuous considering the highly individualized and intensive nature of IT and the lack of prior evidence pointing to superiority of HT. Therefore, we did not expect to find any differences between the two treatment modalities.

Regarding the second question, however, we expected greater stability of treatment effects in the HT group, reflected by favorable follow-up outcomes and, in consequence, lower rates of readmission. This expectation was based on theoretical assumptions detailed in Chapter 2A, particularly the strong systemic focus, family involvement as co-therapists, and a better transfer back to everyday life after discharge.

Study 2

Pilot Evaluation: Treatment Outcomes

Appendix B

Graf, D., Lerch, S., Böhnke, U., Reichl, C., Kindler, J., Koenig, J., & Kaess, M. (2021). Treatment outcome of an intensive psychiatric home treatment for children and adolescents: a non-randomized controlled pilot evaluation. *European Child and Adolescent Psychiatry, 32*, 685–695. https://doi.org/10.1007/s00787-021-01919-y

The second study was a non-randomized controlled pilot evaluation to assess the clinical outcomes of the AT_HOME program for children and adolescents with acute mental disorders. Data from 37 children and adolescents aged 6 to 17 years who received HT in AT_HOME (mean age at baseline: 13.65 ± 2.75 years; 43.2% female) were compared with data from 96 patients who received IT in one of the CAP wards during the same period (13.73 ± 3.01 years; 58.3% female). Although group assignment was not randomized, the distribution of sex and age did not differ across groups; however, the distribution of primary diagnoses did (with more affective disorders in the IT group and more anxiety disorders in the HT group). The primary outcome was psychopathological distress, assessed at admission and discharge using the *Health of the Nation Outcome Scale for Children and Adolescents* (HoNOSCA[-SR], clinician-rated and self-rated versions; Gowers et al., 1999; Gowers et al., 2002). Secondary outcomes included psychosocial functioning and treatment satisfaction. Treatment trajectories within groups were analyzed using paired t-tests. For outcome comparisons between groups, we estimated the average treatment effect using augmented inverse probability weights to adjust for baseline differences given the non-randomized design (for further details, see Kurz, 2022).

Patients in the HT group showed significant reductions in HoNOSCA scores from admission to discharge for both clinician-ratings (d = -0.79) and self-ratings (d = -0.63). When comparing the two groups, we found no significant differences in the average treatment effect between AT_HOME and IT, for both clinician-ratings ($\Delta_{\text{AT\_HOME-HT}}$ = 0.05, [95% CI; -2.18 to 2.28], p = 0.96) and self-ratings ($\Delta_{\text{AT\_HOME-HT}}$ = 0.92, [95% CI; -2.78 to 4.61], p = 0.63). Treatment satisfaction was high across both groups, with no significant differences in patient and parent satisfaction scores. However, treatment duration differed significantly, with the HT group having a shorter duration.

These results indicate that HT was effective in reducing psychopathological symptoms in children and adolescents with acute mental disorders. The absence of significant differences in outcomes between HT and IT is encouraging, as it suggests that AT_HOME is as suitable as IT

for addressing the needs of this population. Nonetheless, some methodological issues limit the generalizability of these findings and the pre-post design of the study only allowed the examination of direct treatment trajectories. No assessment of the stability of treatment effects was possible, which is of particular importance and interest, as elaborated in Chapter 2 and detailed in Chapter 3B.

Study 3

Pilot Follow-Up: Outcome Stability

Appendix C

Graf, D., Lerch, S., Böhnke, U., Reichl, C., & Kaess, M. (under review at *European Child and Adolescent Psychiatry*). Comparison of the long-term outcome of home vs. inpatient treatment: 18-24 months follow-up of a non-randomized controlled trial.

The trial was preregistered at the German Clinical Trials Register (DRKS00025424; May 27, 2021).

In the second study, we found no differences in the effectiveness of HT in AT_HOME in treating children and adolescents with acute mental disorders compared with IT. The aim of the third study was to examine the stability of these improvements over time. Therefore, we conducted a follow-up study, contacting all families who had been included in the initial pilot study 18 months after discharge. Consistent with the original evaluation, we assessed psychopathology using the HoNOSCA[-SR] and psychosocial functioning using the *Global Assessment of Functioning Scale* (GAF; American Psychiatric Association, 1994; Hall, 1995). We also collected data on subsequent use of mental health services during the follow-up period using the *Mannheim Resource Module* (MRV; Salize & Kilian, 2010; Voß & Salize, 2016). Assessments were conducted via telephone interviews which were recorded and rerated by a second, blinded rater. Interrater reliability was high for HoNOSCA ratings ($\kappa = 0.77$) and very high for GAF ratings (ICC = 0.95). Given the longitudinal design with three outcome measurement points, we could not apply the augmented inverse probability weights described in the second study. Instead, we employed linear mixed models, accounting for the main effects of treatment group (HT, IT) and time points (admission, discharge, follow-up) and their interactions. These group-by-time interactions were followed by contrasts to test the hypothesized advantages of HT in achieving better outcomes in HoNOSCA(-SR) and GAF at follow-up. We implemented inverse

probability weighting (Austin et al., 2021; Kuss et al., 2016) to balance pretreatment characteristics and controlled for sex, age at study entry, treatment duration, and post-discharge treatments.

Average follow-up period was 21.35 ± 2.36 months. A total of 27 patients who had received HT consented to participate in the follow-up study (79% of the original sample, 48% female, mean age 15.15 ± 2.77 years). In the IT arm, 48 patients participated (53% of the original sample, 69% female, mean age 16.35 ± 2.87 years). Post-hoc contrasts of group-by-time interactions were significant for the HoNOSCA, with lower scores in the HT group at follow-up (β = -4.25 [95% CI: -7.64 to -0.86], *SE* = 1.73, p = 0.014), and for the GAF, with higher scores in the HT group at follow-up (β = 12.09 [95% CI: 4.48 to 19.70], *SE* = 3.88, p = 0.002). No significant differences were found for the HoNOSCA-SR (β = -2.46, [95% CI: -9.16 to 4.30], *SE* = 3.43, p = 0.48). Figure 3 illustrates the model predictive values of the outcome trajectories

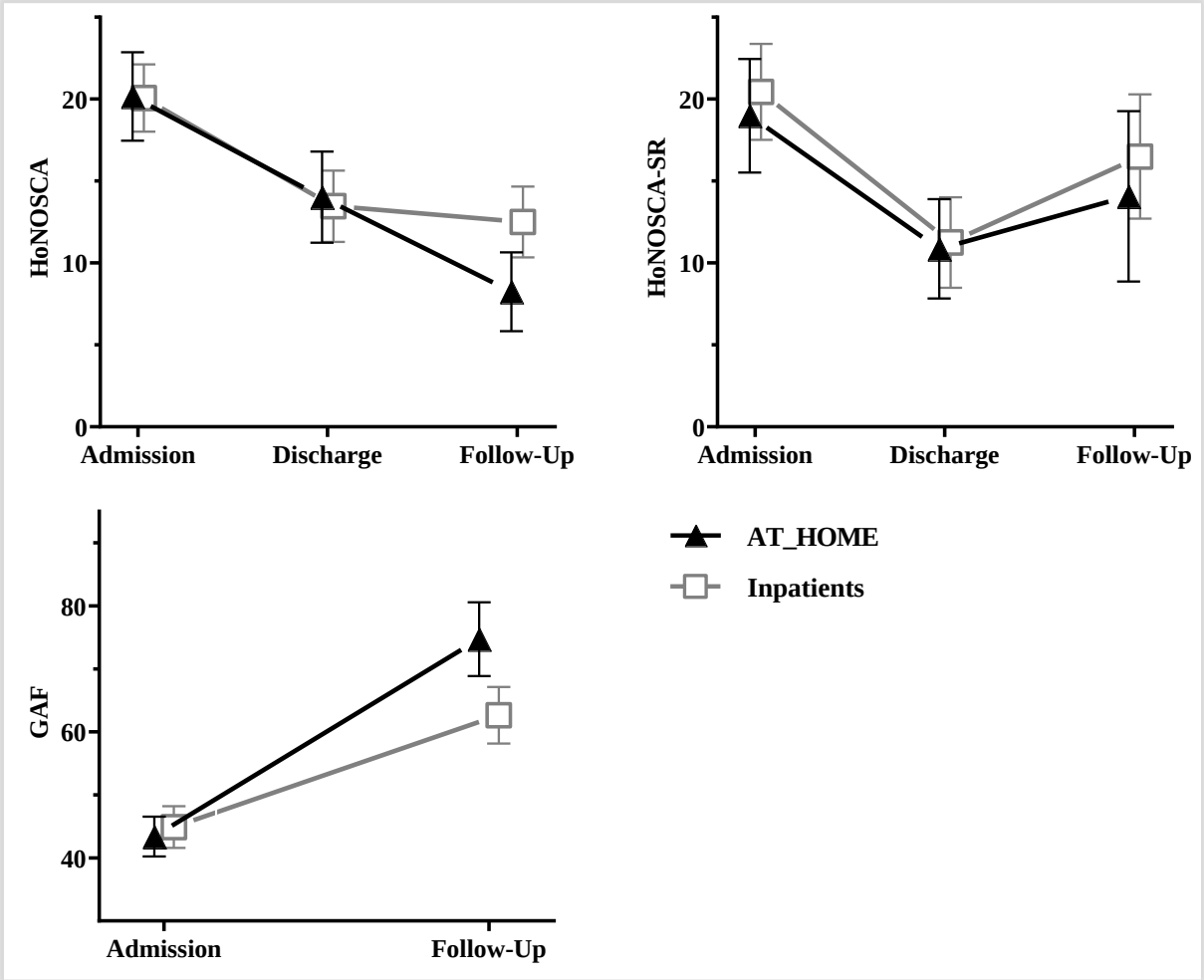

Figure 3 Model predictive values (Mean ± 95% confidence interval) of the trajectory of the primary outcomes in the two groups over time
HoNOSCA(-SR) = Health of the Nation Outcome Scale for Children and Adolescent (Self-Rating), GAF = Global Assessment of Functioning Scale

for both groups over time. The use of subsequent mental health services during the follow-up period did not differ between the treatment arms.

The results of clinician-rated outcomes align with the expectation that HT is particularly effective in the long term. However, the self-rated outcomes did not follow the same positive trajectory. One possible, though not entirely satisfactory, explanation for this discrepancy may be the general challenges adolescents faced in transitioning from treatment to everyday life, particularly in the context of the COVID-19 pandemic. Overall, readmission rates during the 21 months between discharge and follow-up were high and did not differ between the two treatment arms, contrary to the expectation that greater clinical improvement in the HT arm would lead to a reduction in subsequent treatment. In summary, these results suggest that HT is particularly effective in the long term; however, questions remain regarding the discrepancy between self-rated and clinician-rated outcomes and why the use of subsequent treatment did not differ between the two groups.

4 Discussion

This thesis presents a comprehensive approach to HT as an alternative to IT in child and adolescent psychiatry, contributing to the growing body of knowledge on this treatment modality across three studies. The first study reviewed and conducted a meta-analytic aggregation of previous clinical trials. Studies 2 and 3 evaluated the clinical outcomes of the AT_HOME program at the CAP Bern, both in the immediate treatment phase (Study 2) and over the long term (Study 3). The following sections discuss the implications of the three studies and address methodological limitations that should be considered for interpreting these results and planning future research.

4A Meta-Analysis – Implications & Limitations

Based on a systematic literature search, we conducted a meta-analysis of clinical trials comparing HT in child and adolescent psychiatry with an active IT control group. The synthesis of the 30 identified studies did not reveal any significant differences between HT and IT in improving psychosocial functioning and psychopathology, either in superiority or non-inferiority testing.

Interestingly, though several systematic reviews have previously addressed the same topic, none synthesized the existing evidence, as “included papers did not allow sufficiently robust

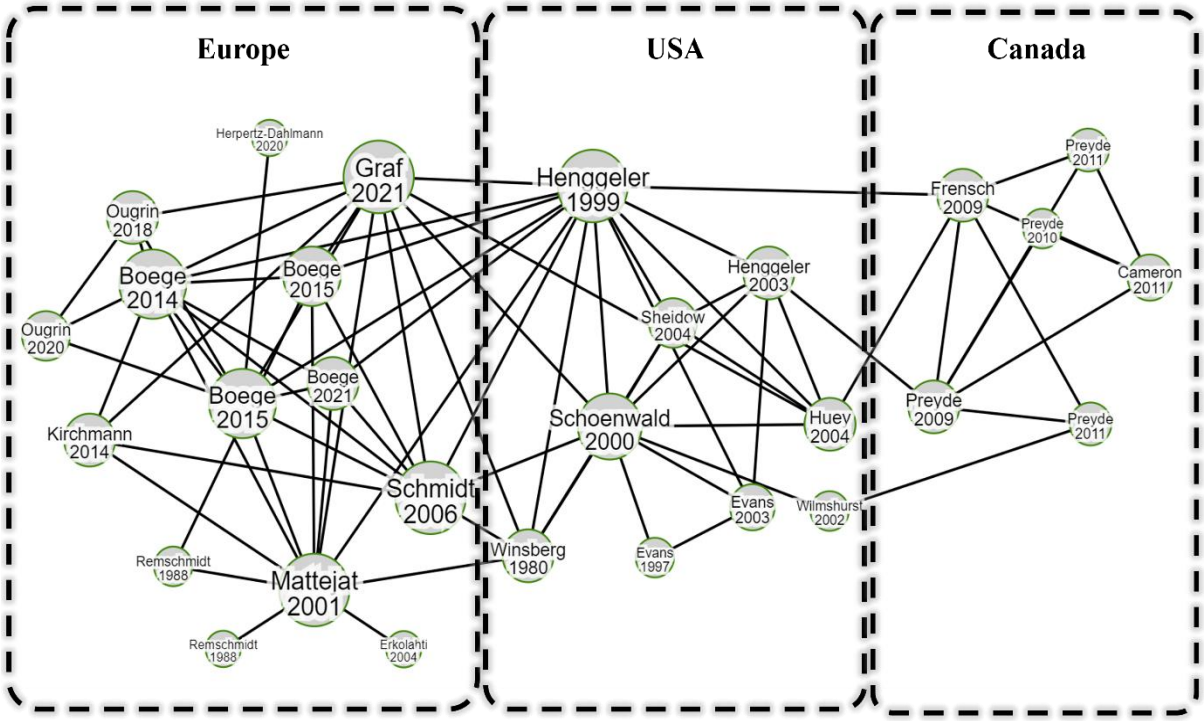

Figure 4 Citation networks between articles included in the meta-analysis. Three main clusters were identified and mapped by visual inspection

information to perform meta-analysis" (Clisu et al., 2022, p. 37). However, given the lack of a general guideline on how many studies are needed to perform a meta-analysis, we argue that it is feasible and the most valid synthesis technique when at least two studies on the same topic exist (Valentine et al., 2010). This procedure allows a transparent review of the limitations and heterogeneity in the existing literature which might be addressed in future research (Higgins et al., 2019; Higgins et al., 2003). Following a theory-driven, pre-registered, and transparent analysis protocol, our findings confirmed significant variations across studies, reflected by substantial statistical heterogeneity. For illustrative purposes, Figure 4 visualizes the relationships among the studies included in the meta-analysis, showing the citation networks between articles. Notably, three clusters of studies evaluating different HT programs were identified by visual inspection: one cluster comprises clinical trials from Canada that evaluated HT as an alternative to residential home placement; a second cluster predominantly includes studies from the United States focusing on HT within the structured framework of MST for patients in acute psychiatric crises; and a third cluster consists of studies from European countries (Germany, United Kingdom, Switzerland, Finland) focusing mainly on HT programs designed to shorten or entirely replace hospitalization. This abbreviated overview already conveys a sense of the substantial differences among the studies regarding (a) the clinical implementation of the HT program and the quality of the inpatient control group, (b) the quality and selection of outcomes

and their measurement, (c) the reporting of relevant statistics, and (d) the distribution across countries and time periods. Consequently, it was not possible to identify specific patient populations that benefited more or less from HT, as recently reported in adult psychiatry in a systematic review (Bergamaschi et al., 2024). In our meta-regression, only two moderators were significant: Patient groups with higher levels of psychopathology at baseline (relative to the other group) showed greater improvements in post-treatment outcomes, suggesting that both IT and HT may be particularly effective for patients with a high psychopathological burden. Additionally, study design moderated post-treatment psychopathology, with effect sizes favoring HT over IT when considering only RCTs. The latter finding underscores the importance of rigorous methodological approaches, as RCTs provide the most convincing evidence of intervention effects (Higgins et al., 2019). Nonetheless, given the small number of clinical trials reported in previous systematic reviews, we decided to include non-randomized clinical trials in our analysis. Even considering nRCTs, the limited number and small sample sizes of studies meeting the inclusion criteria likely resulted in underpowered meta-analyses.

Despite these concerns regarding methodology and the underlying literature (along with additional limitations detailed in the original article in Appendix A), the meta-analysis provides important insights. The systematic assessment and quantification of the quality of current knowledge made it possible to identify several sources of heterogeneity and derive proposals to address existing limitations in future studies. Most importantly, however, we found no evidence that IT is more effective than HT (superiority meta-analysis) nor that HT is less effective than IT (non-inferiority meta-analysis). These results are in line with the DGPPN's assessment that "the evidence base for home treatment of various severe psychiatric disorders in children and adolescents is now very convincing" (translated from the S3-Leitlinie Psychosoziale Therapien bei schweren psychischen Erkrankungen; 2019, p. 403), an appraisal made even before a meta-analysis on this topic was conducted. In this context, the existence of several non-controlled HT evaluation studies not described in this (or previous) review is worth noting. Although they play a secondary role in evaluating HT as an alternative to IT, these studies provide insight into individual implementations and experiences across countries (the Netherlands: Muskens et al., 2019; Switzerland: Rhiner et al., 2011; US: Seelig et al., 1992), with reported within-group effect sizes comparable to those of the controlled studies identified in our systematic search.

4B AT_HOME Pilot Studies – Implications & Limitations

The results of the two pilot studies are discussed together, as they are part of the same evaluation trial, based on the same patient sample, and share several implications and limitations.

To summarize, Study 2 found no significant differences in short-term clinical outcomes between HT in the AT_HOME program and IT in a psychiatric inpatient unit. Consistent with the meta-analysis findings, these results suggest that the daily therapeutic visits by a multidisciplinary team provided a sufficiently intensive level of care to meet the needs of patients with acute psychiatric disorders. Treatment included the full range of evidence-based, symptom-specific psychiatric therapy elements, such as specialized techniques (e.g., DBT-A) and psychopharmacology, no different from IT, which also did not provide continuous therapy throughout the day. Thus, the ratio of psychotherapy sessions was comparable in both modalities.

However, a distinct advantage of HT is the strong involvement of the system. Conducting therapy within the family context can help identify dysfunctional behavior or maladaptive reinforcement patterns that may go unnoticed in an inpatient setting. These dynamics can be directly targeted using cognitive/behavioral therapeutic elements, e.g., by reinforcing positive behaviors rather than solely reacting to misbehavior. A second key distinction between HT and IT lies in the time between therapy sessions. While IT provided a structured environment with a clinic school, free time, and specialized treatments (e.g., group therapy sessions), patients and their families in AT_HOME navigated daily life without external supervision, practicing and integrating therapeutic strategies independently. According to family systems theory, systemic changes achieved during treatment can also actively impact the patient during the time between sessions (Wasik & Bryant, 2001). Moreover, while having a systemic focus, HT still directly addresses the patient's individual issues, providing close in vivo support for important developmental milestones, which can be considerably disrupted by mental disorders (including identity and relationship formation as well as educational and vocational attainment, financial independence, Dalsgaard et al., 2020; Mojtabai et al., 2015). For example, a change of school or development of an educational perspective, may influence psychopathological symptoms. Therefore, despite not providing the round-the-clock structure of IT, which may facilitate more immediate changes over a relatively brief treatment period (Schmidt et al., 2006), it seems reasonable that treatment trajectories were similar in HT – although the recovery processes may have differed.

The findings of Study 3 suggest that these treatment effects were more stable in the HT arm compared to the IT arm regarding clinician-rated psychopathology and psychosocial functioning. However, the term "stability" may be somewhat misleading in this context, as clinician-

rated psychopathology scores continued to decrease over the 21-month follow-up, with the HT group showing a significantly faster improvement rate, making HT also interesting for its potential to reduce the substantial proportion of "revolving door" patients reported in psychiatric populations (Brinkmeyer et al., 2016; Bruns & Burchard, 2000).

To recapitulate, the assumption underlying these beneficial long-term effects, derived from ecological and systemic theories (Bronfenbrenner, 1979; Minuchin, 1974), was that the strong involvement of the patient's system would facilitate better transition back to everyday life post-discharge. Additionally, following the triadic model of therapy, the empowerment of the family as mediating co-therapists would help maintain treatment achievements beyond therapy (Tharp & Wetzel, 1975). A third aspect concerns the focus of HT on activating resources within both the individual and their environment, which may be reflected in the high rate of subsequent treatment observed during follow-up. While readmission is often seen negatively as an indicator of relapse or recurring issues, seeking professional help when needed could also represent a valuable resource. Delivering therapy within the community may help reduce stigma and negative attitudes toward psychiatry, which are known barriers to help-seeking in young patients (Cavelti et al., 2024; Radez et al., 2021).

However, while the findings of the general long-term effectiveness of HT supports these assumptions, the study design limits our understanding of the mechanisms and specific components driving these results. A similar limitation was the lack of subgroup analyses due to small sample sizes. Consequently, we could not explore the question of what works for whom, despite the importance of psychotherapy research in matching treatments to individual patient needs (Pietrabissa et al., 2022; Reimer, 1983, according to Kiesler, 1977, and Grawe, 1978). Preliminary research has sought to identify relevant subgroups; for example, Reimer (1983) found that HT was less effective with older mothers, while Remschmidt (1988) suggested HT might be more suitable for older adolescents. However, these studies were constrained by small samples and methodological issues, and the question remains as to whether certain psychiatric disorders have a better prognosis with HT than others. For example, our study found a higher proportion of patients with anxiety disorders in the HT arm compared to the IT arm. It is plausible that these patients and their families preferred treatment without leaving their "safe space". However, this preference might also reflect avoidance behavior, and overcoming the challenge of inpatient admission could offer therapeutic benefits given the extensive evidence for the effectiveness of exposure therapy (e.g., Whiteside et al., 2020). Moreover, systemic factors may also be relevant for the decision for or against HT. Families highly motivated to engage in treatment are more likely to show greater treatment compliance (Schmidt et al., 2006) and, consequently,

achieve better outcomes (Loh et al., 2007; Wu et al., 2020). Conversely, if a family is already at a breaking point, there may be insufficient energy to engage in intensive therapy, and the temporary removal of the patient via IT could offer necessary relief (Kirchmann et al., 2014). However, as these considerations remain speculative, future research is needed to identify individual and systemic characteristics that guide the indication for either HT or IT.

For both studies, additional methodological limitations should be considered. The non-randomized design, relatively small HT sample size, and unblinded outcome assessments limit the generalizability of the findings. Moreover, the restricted range of predetermined measures at admission and discharge, as defined by the ANQ initiative, did not allow for more nuanced questions, such as discrepancies between clinician- and self-rated outcomes.

Regarding Study 2, the use of superiority analyses presents a specific limitation, as the intention was not to establish HT's short-term superiority over IT, but rather to demonstrate that both treatments are equally effective. While augmented inverse probability weights offer a double-robust analysis technique recommended for evaluating non-randomized clinical trials (Kurz, 2022), this approach is not optimal for non-inferiority comparisons. Finding no differences between the two conditions does not preclude the absence of real differences (Schumi & Wittes, 2011). Specific non-inferiority statistical approaches exist (e.g., Piaggio et al., 2012), but require larger sample sizes than superiority testing (Kaul & Diamond, 2007) which was impractical given our limited sample of 37 HT patients. A post-hoc power analysis indicated that group differences of $d = 0.54$ could be detected with high statistical power ($1 - \beta = 0.8$), suggesting that large differences are unlikely to have been missed, although they cannot be entirely ruled out.

A particular concern of Study 3 was the uneven participation rates between groups, with nearly 80% of eligible HT patients and only 53% of eligible IT patients consenting to follow-up. This discrepancy raises the potential for non-response bias (Compton et al., 2019; Johnson & Wislar, 2012), although follow-up participants did not significantly differ in demographic distribution from the original sample.

4C Outlook

Based on the current findings and identified limitations, several implications emerge for the future implementation of HT programs and evaluation studies. Study 1 showed that, according to existing evidence, clinical and policy decision-makers may consider HT a viable alternative to IT in child and adolescent psychiatry. The systematic quality assessment and comparison of

prior studies further highlighted the need for consistent terminology, suggesting more standardized implementation in future programs (e.g., following Keiller et al., 2023). The results also enabled recommendations for a more consistent evaluation strategy in future trials, including a focus on psychosocial functioning and psychopathology as primary outcomes, the use of reliable and validated instruments (e.g., Kwan & Rickwood, 2015; or the International Consortium for Health Outcomes Measurements, Krause et al., 2021), and the mandatory inclusion of at least one follow-up assessment to account for long-term effects.

Building on these meta-level considerations, Studies 2 and 3 offer micro-level methodological and clinical implications for future research on AT_HOME and similar HT projects:

(1) First, to address the limitations of the current findings, future research should include randomized group assignments to enhance external validity and generalizability. Larger sample sizes are required to conduct subgroup analyses to better understand which patients benefit most from HT and in what circumstances HT may be less suitable. Such analyses may take into account both individual factors (e.g., age, symptom patterns, and severity) and systemic factors (e.g., family dynamics, school holidays). For the same reason, a broader range of outcome measures beyond those used in the pilot evaluation could provide deeper insights into treatment effects, which brings us to the second point.

(2) To understand the mechanisms and specific components behind the effectiveness of HT, more sophisticated study designs are needed that go beyond pre-post measures. High-resolution data collection could help identify which treatment components are effective, ineffective, or even counterproductive. Additionally, assessing systemic factors like family functioning and data from multiple sources (e.g., parents, teachers, peers) could elucidate the mechanisms at play during treatment and evaluate theoretical assumptions. For instance, one might expect an initial stagnation or deterioration of symptoms due to the added burden of therapy, followed by gradual improvement as systemic changes take effect on the patient.

These questions could be explored using high-resolution data collection methods, such as Ecological Momentary Assessments (EMA), completed by both patients and the treatment team. Leveraging recent technological advances, such as smartwatch-based real-time monitoring, could enhance data quality (Miller et al., 2022; Smail et al., 2023). In addition, this approach could be combined with app-based therapy supplementation, which has been proposed as a low-threshold way to reduce treatment costs and extend reach to a broad and young audience (e.g., Cohen et al., 2021). HT might be an ideal setting for this, as research suggests that blended care – combining face-to-face and app-based interventions – is especially effective (Hollis et al.,

2017; Lehtimaki et al., 2021). Integrating an app during HT could improve adherence and support patients and families post-discharge, facilitating the transition of therapy achievements

(3) A third point concerns the flexibility of treatment intensity and exploring the optimal dose-response ratio of HT sessions. The current program is designed entirely without IT elements, which is essential to evaluate the isolated effect of HT, as previous studies that combined HT and IT have struggled to disentangle the effects of both modalities (Boege et al., 2021; Ougrin et al., 2021; Winsberg et al., 1980). In addition, AT_HOME is structured without a gradual decrease in treatment frequency. Previous studies have reported that patients wished for better support in the transition from treatment to daily life (Herpertz-Dahlmann et al., 2020; Kirchmann et al., 2014). Although HT theoretically better prepares patients for this transition, a potential program enhancement could involve dynamic adjustments in treatment intensity. For example, rather than 12 weeks of daily visits, the program could shift to 8 weeks of daily sessions followed by 8 weeks of 2-3 sessions per week, maintaining the overall therapy dose but altering its cadence. However, these clinical considerations need to be balanced against administrative and financial consequences. A future RCT could compare a group of HT patients with such a flexible approach with a control group following the existing structure.

(4) Finally, the current findings have primarily clinical relevance, focusing on psychopathology and functional outcomes. However, economic evaluation is another important aspect of HT. Several conclusions can be drawn from our findings: HT was found to be more effective at follow-up, with no differences in subsequent treatment use, and previous literature suggests lower treatment costs for HT compared to IT (Boege et al., 2015; Ougrin et al., 2018; Sheidow et al., 2004). Consequently, the cost-effectiveness ratio in the AT_HOME program is likely to be favorable compared to IT. Nonetheless, the data presented here do not provide a definitive answer to this question, although treatment costs could be derived from clinic records and post-discharge treatment use assessed with the MRV. Secondary analyses of the present data, as well as future trials, should incorporate cost data from both initial and subsequent treatments to evaluate cost-effectiveness and address whether HT can help meet the increasing demand for mental health care in a context of limited resources.

5 Conclusion

This thesis presented three studies addressing different aspects of HT in child and adolescent psychiatry. We found evidence on both macro- and micro-levels that HT is no less effective than IT for the treatment of children and adolescents with acute psychiatric disorders. Furthermore, we found that HT resulted in better long-term outcomes. The studies also highlighted important methodological issues that currently limit the available evidence and identified starting points and recommendations for future HT programs and evaluation trials to address these limitations. Nevertheless, what we know so far and what we found in our studies is promising, especially considering the high quality of the IT control group used in the pilot evaluation. Consequently, the present work aims to highlight the potential of HT as an effective and sustainable component in addressing the challenges faced by strained mental health systems, and to support the paradigm shift from traditional treatment in the clinic to treatment provided AT_HOME.

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STATEMENT OF AUTHORSHIP

Hiermit bestätige ich, dass ich die Dissertation

«Bringing Therapy AT_HOME – On the Potential of Home Treatment as Alternative to Inpatient Treatment in Child and Adolescent Psychiatry»

im Fach Psychologie

unter der Leitung von Prof. Dr. Stefanie Schmidt
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Bern, 01.10.2024

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FULL-TEXT ARTICLES

Appendix A

Effectiveness of home treatment in children and adolescents with psychiatric disorders-systematic review and meta-analysis.

Daniel Graf, Christine Sigrist, Isabel Boege, Marialuisa Cavelti, Julian Koenig,

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RESEARCH ARTICLE

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Effectiveness of home treatment in children and adolescents with psychiatric disorders—systematic review and meta-analysis

Daniel Graf[1], Christine Sigrist[2], Isabel Boege[3], Marialuisa Cavelti[1], Julian Koenig[2] and Michael Kaess[1,4*]

Abstract

Background Home treatment in child and adolescent psychiatry offers an alternative to conventional inpatient treatment by involving the patient's family, school, and peers more directly in therapy. Although several reviews have summarised existing home treatment programmes, evidence of their effectiveness remains limited and data synthesis is lacking.

Methods We conducted a meta-analysis on the effectiveness of home treatment compared with inpatient treatment in child and adolescent psychiatry, based on a systematic search of four databases (PubMed, CINAHL, PsychINFO, Embase). Primary outcomes were psychosocial functioning and psychopathology. Additional outcomes included treatment satisfaction, duration, costs, and readmission rates. Group differences were expressed as standardised mean differences (SMD) in change scores. We used three-level random-effects meta-analysis and meta-regression and conducted both superiority and non-inferiority testing.

Results We included 30 studies from 13 non-overlapping samples, providing data from 1795 individuals (mean age: 11.95 ± 2.33 years; 42.5% female). We found no significant differences between home and inpatient treatment for postline psychosocial functioning (SMD = 0.05 [− 0.18; 0.30], $p = 0.68$, $I^2 = 98.0\%$) and psychopathology (SMD = 0.10 [− 0.17; 0.37], $p = 0.44$, $I^2 = 98.3\%$). Similar results were observed from follow-up data and non-inferiority testing. Meta-regression showed better outcomes for patient groups with higher levels of psychopathology at baseline and favoured home treatment over inpatient treatment when only randomised controlled trials were considered.

Conclusions This meta-analysis found no evidence that home treatment is less effective than conventional inpatient treatment, highlighting its potential as an effective alternative in child and adolescent psychiatry. The generalisability of these findings is reduced by limitations in the existing literature, and further research is needed to better understand which patients benefit most from home treatment.

Trial registration Registered at PROSPERO (CRD42020177558), July 5, 2020.

Keywords Home treatment, Treatment setting, Child and adolescent psychiatry, Treatment research, Meta-analysis

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Background

Most mental disorders have their onset in childhood or adolescence [1, 2], with global point prevalence estimates at nearly 14% in this young population [3]. Recent research suggests that the global COVID-19 pandemic in early 2020 has contributed to an increase in the prevalence of affective, eating, and anxiety disorders, as well as in emergencies involving self-harm [4–7]. Simultaneously, the pandemic has increased the media presence of mental health in young people, reducing the stigma associated with mental disorders [8] and promoting more positive attitudes toward seeking professional help [9]. Both of these factors contribute to growing waiting lists for admission to inpatient treatment (IT) [10–12], exacerbating a long-standing problem in child and adolescent psychiatry [13, 14].

Home treatment (HT) is not new to the field of child and adolescent psychiatry but is becoming increasingly important to address these challenges promising a possible alternative to IT that can be more rapidly implemented and scaled up. Different to IT, the young patients remain in their home environment and are visited on a frequent and regular basis by a multi-professional treatment team, including child and adolescent psychiatrists and psychotherapists, social workers, and nursing staff. The close involvement of the patient's family, school, and the broader social environment (e.g. peers) in therapy allows problems to be observed and addressed where they arise, holding the potential to increase sustainability of treatment effects and reduced readmission rates [15, 16]. Furthermore, HT has been suggested to be more cost-effective than IT [17], supported by two studies in the general child and adolescent psychiatry using acceptability curves based on QALYs [18] and the incremental cost-effectiveness ratios (ICER) based on changes in the psychosocial functioning [19]. Consequently, HT could allow treatment to be offered to a greater number of patients at the same cost.

These considerations of HT, its rationale, and implementation in general psychiatry date back to the 1960s [20]. In child and adolescent psychiatry, HT programmes were implemented as early as the 1970s and 1980s in the USA [21] and Europe [22]. Further clinical trials followed over the last four decades and several reviews were published, providing an overview of the consistently growing body of literature [23–28]. These reviews highlight the potential of HT as a promising alternative to IT; however, their conclusions are limited by the sparse underlying evidence and the small study samples. In addition, to the best of our knowledge, no meta-analysis of trials examining the effectiveness of HT in child and adolescent psychiatry has been conducted, as done previously for adult psychiatry [29, 30].

To close this gap, we updated the most recent literature searches on this topic in 2020 [23, 27] and conducted a meta-analysis to investigate the effectiveness of HT as an alternative to IT for children and adolescents with mental disorders. In addition, we sought to explore patient subgroups that are more likely to benefit from HT, taking into account various demographic and contextual variables.

Methods

This systematic review and meta-analysis followed the PRISMA guidelines [31] (checklist in Additional file 1, pp. 2–4). The study protocol was registered at PROSPERO (registration CRD42020177558).

Search strategy and selection criteria

We systematically searched PubMed, CINAHL, PsychINFO, and Embase for relevant articles in April 2020, with two updates in December 2022 and December 2023 (search strategy detailed in Additional file 1, Table S2). Additionally, we performed manual backward and forward snowballing of the reference lists of included articles and contacted the authors of all included studies to inquire about other potential HT trials or experts in the field. We did not search grey literature or trial registries. One rater (DG) screened titles and abstracts for inclusion/exclusion criteria, followed by full-text screening, using the Rayyan web application for systematic reviews [32]. To test robustness of the screening process, a random 10% sample of identified records was screened by a second rater (SE). The decisions for inclusion or exclusion were in complete agreement. Full texts were obtained online, through interlibrary loan [33], and from antiquarian bookshops [22, 34]. The inclusion criteria were as follows: empirical clinical trials published in English- or German-language journals or books; intervention: HT equivalent to IT and presence of a control group receiving IT or equivalent care; population: patients with psychiatric diagnoses; mean age $\leq$ 21 years. Non-randomised controlled trials (nRCTs) were included due to the previously reported paucity of randomised controlled trials (RCTs) in this research area [24] and concerns about the generalisability of RCTs to real-world contexts [30].

Experimental and control treatment

Although recent literature provides more clarity and consensus regarding the nature and scope of intensive community care services [35], "home treatment" was often used in the past (and still is used) as an umbrella term for treatments delivered in a home-based setting, including supported discharge service (SDS) [36], Home-Based Crisis Intervention (HBCI) [37], Multisystemic Therapy (MST) [38], and others [30]. In the present study, we defined HT as an intensive psychiatric treatment

delivered in a home-based setting that was intended to entirely replace or shorten an inpatient stay ("equivalent" to IT) [30, 39]. Treatment programmes with different names that met the above criteria were considered HT (e.g. MST as an alternative to hospitalisation) [38]. The key element of all HT programmes was that they offered treatment outside of the clinic, which would have been the alternative treatment. Therapy sessions were primarily conducted at the patient's home but additional options such as school visits or assistance with daily activities like using public transport or grocery shopping were often available. Presence of day services such as day clinic or group therapy carried out in the clinic was no criterion for excluding a HT programme, provided the majority of the treatment took place in the home environment. We defined IT as treatment delivered in a hospital ward or similar institutional setting, including residential care [40].

Choice of primary and secondary outcome

The primary outcomes were psychosocial functioning and psychopathology. These outcomes are considered relevant for daily life functioning, also from the perspective of youth with lived experience [41], and sensitive to changes over the course of treatment. Secondary outcomes included treatment cost, duration, and satisfaction. Where appropriate, we combined similar outcome measures from different instruments and studies (e.g. different instruments assessing "psychosocial functioning"). Details on the grouping of instruments are provided in the Additional file 1 (pp. 5–7). Outcome measures were categorised according to their source of information (clinician-rated, self-rated, parent-rated).

Data extraction and processing

Two reviewers (DG and SO) independently extracted information about the treatments (description, duration, intensity), study population (sample size, dropouts, age and sex distribution, primary psychiatric diagnoses), study design (randomisation, timing of endpoints), and outcome measures for each group and time of assessment (i.e. *n*, *M*, *SD/var*). If relevant data was not reported in the studies, we contacted the authors to obtain the information (response rate: 50%) or derived it by calculation of other data reported in the article (Additional file 1, p. 8).

Risk of bias assessment

We assessed the methodological risk of bias using the "Cochrane Collaboration Risk of Bias 2.0" (ROB2) [42] for RCTs and the "Risk Of Bias In Non-randomised Studies—of Interventions" (ROBINS-I) [43] for nRCTs. RCTs were categorised as having low, medium, or high risk of bias based on the following criteria: randomisation process, deviations from planned interventions, missing outcome data, outcome measurement, and selection of reported outcomes. nRCTs were classified as having low, moderate, serious, or critical risk of bias based on the following criteria: confounding, selection of study participants, classification of interventions, deviations from planned interventions, missing data, measurement of outcomes, and selection of reported results.

Calculation of effect size measures

We calculated the standardised mean difference (SMD) for each outcome as the effect size measure, comparing HT to IT based on the difference between baseline and (a) postline values or (b) follow-up values, if available. For RCT studies, we employed formulas proposed by Becker [44] and Carlson and Schmidt [45] as described in Morris [46] to estimate SMD (d_{ppc}). Due to the common scenario of unknown correlation between pre- and post-treatment measures in meta-analysis, we assumed $\rho = 0.50$. For nRCT studies, meta-analytic procedures were adjusted to account for the precision of effect sizes. For each study, the difference between the sample means at post-treatment or follow-up was divided by the pooled standard deviation at baseline and corrected for small-sample bias [47]. The exact formulas were used in this calculation of Hedges' *g* and corresponding standard errors [48]. Readmission rates reported as percentages were translated to a 2×2 frequency table, based on which respective log odds ratios were calculated [49, 50]. For studies reporting mean readmissions, SMDs were calculated and converted into log odds ratios (e.g. [51–54]), which were back-transformed into regular odds ratios (OR) for better interpretability after data synthesis. An OR above 1 indicated a higher rate of readmission after IT compared to HT, whereas an OR below 1 indicated the opposite.

Data synthesis

In most cases, effect sizes were nested within clusters of individual study samples based on rater perspective and time of assessment. That is, separate meta-analyses were conducted for post-treatment and follow-up effects. Clustering was specified for rater perspective for primary outcomes and treatment satisfaction, and for time of measurement for treatment costs. Three-level random-effects meta-analytical models [55], which allow effect sizes to vary between participants (level 1), outcomes (level 2), and studies (level 3) [56], were used to synthesise the cluster effects. We used inverse variance weighting and a restricted maximum likelihood estimator (REML) to estimate level 2 and level 3 τ^2 values. Heterogeneity was assessed using a generalised/weighted least squares extension of Cochran's test [57]. For the synthesis

of the treatment duration data, a conventional (two-level) meta-analytical model was used given the lack of clustering in these data. Inverse variance weighting and REML were used to estimate level 2 τ^2. Confidence intervals for individual studies and tests of individual coefficients and confidence intervals were calculated based on a *t*-distribution (with degrees of freedom), such that the omnibus test used an *F*-distribution [58]. Forest plots were used to visualise meta-analytical summary models for outcome, and funnel plots were used to visually explore asymmetry. We conducted data analysis using the R-packages "meta" and "metafor" [57, 59].

Moderator analyses

Meta-regression analyses were conducted to separately examine the potentially moderating effects of various factors on the effectiveness of HT compared with IT, including mean age (in years), sex (% female), mean duration of treatment (in days), study design (RCT vs. nRCT), type of HT (adjunctive to IT vs. substitute for IT), and presence of day services (provided during HT vs. not provided). Baseline scores of the primary outcomes were considered both as pooled mean scores to test whether generally higher or lower levels influenced post-treatment outcomes and as the difference in means ($\Delta = M_{HT} - M_{IT}$) to account for differences between groups at the onset of treatment, which can be expected particularly in nRCTs. Multivariate meta-analytical models tested continuous and categorical moderators using an omnibus test (*QM* test) [57]. If a particular moderator was missing, the corresponding study was excluded from the meta-regression analyses. It is important to note that the meta-regression analyses are exploratory in nature and that the results should be interpreted with caution due to the potential for overfitting when the number of studies per covariate examined is small [60]. For the same reason, meta-regression analysis was conducted only for the primary outcomes of psychosocial functioning and psychopathology.

Objective non-inferiority assessment of primary outcomes

Considering that HT as a "novel" treatment is unlikely to be *superior* to IT from a real-world clinical perspective, we additionally conducted *non-inferiority testing* in the meta-analyses of primary outcomes as proposed by Trone et al. [61]. Non-inferiority testing evaluates whether a novel treatment is not worse than the comparator by the degree of "acceptable inferiority", defined by the non-inferiority margin (Δ) based on the reported effect of the active comparator. First, the effect size and corresponding 95% confidence interval (CI) of the active comparator versus an untreated control group (SMD_{Inptr}) were determined. Given the lack of evidence in the literature (i.e. no existing meta-analysis examined the efficacy of IT vs. untreated control), we performed an additional systematic search (detailed in Additional file 1, pp. 9–10) to obtain the effect size (95% CI) of IT for each primary outcome. We defined 50% and 95% as the percentage (alpha) of the effect of IT to test whether the effect was maintained with HT. Δ was calculated using SMD_{Inptr} and the upper bound of the 95% CI of SMD_{Inptr}, respectively (with the latter being the more conservative approach to calculating an objective non-inferiority margin). After calculating Δ, we compared the 95% CI of the summary effect size of HT versus IT for primary outcomes obtained from meta-analysis of the respective RCTs, with the non-inferiority margin (Δ). To demonstrate non-inferiority, the 95% CI of the HT vs. IT comparison should fall entirely on the left (negative) side of Δ.

Results

Our search strategy yielded a total of 4072 unique records from the original search (04/2020) and 1735 additional from two literature update (12/2022 and 12/2023). The PRISMA flowchart in Fig. 1 summarises the selection procedure, which resulted in the inclusion of 28 articles and two books. These 30 publications reported relevant data from 13 non-overlapping samples comprising 1795 individuals (average baseline age: 11.95 ± 2.33 years; 42.5% female).

All included trials are summarised in Table 1. They were conducted in Europe ($k = 8$, 61.5%), the USA ($k = 3$, 23.1%), and Canada ($k = 2$, 15.4%). The majority of the trials used HT to entirely replace IT ($k = 9$, 69.2%) and assigned patients randomly to the treatment groups ($k = 8$, 61.5%). Risk of bias assessments showed moderate-to-high risk for most RCTs and all nRCTs (Additional file 1, Figures S2 and S3).

Psychosocial functioning

For the primary outcome of psychosocial functioning, we excluded one study [21] from the analysis, because the outcomes for the two treatment groups were assessed by two independent rater groups that differed substantially in their ratings. The forest plot in Fig. 2 shows the individual and summary effect size estimates. The final pooled effect size of postline assessments ($n = 9$ studies, $k = 15$ estimates, $N = 1722$) was SMD = 0.02 [95% CI, −0.20 to 0.25], $p = 0.83$. Overall heterogeneity was substantial, with $I^2 = 98.1\%$ ([95% CI, 97.6% to 98.5%], $Q_{14} = 751.48$, $p < 0.001$). Visual inspection of the corresponding funnel plots (Additional file 1, Figure S4) suggested the presence of small study bias and one clear outlier [16]. The meta-regression analyses did not identify any significant moderators (Additional file 1, Table S7).

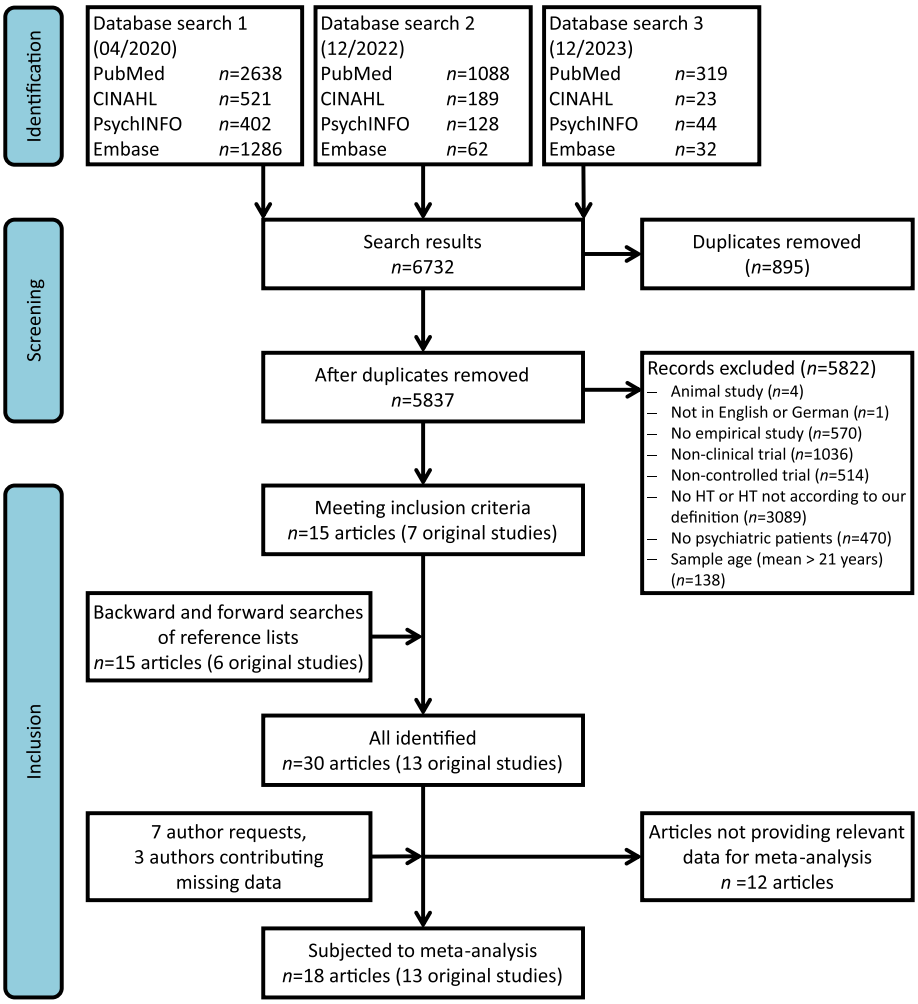

Fig. 1 PRISMA flowchart of the systematic search

For follow-up assessments ($n=5$ studies, $k=7$ estimates, $N=516$), the pooled effect size was SMD = −0.15 [95% CI, −0.39 to 0.09], $p=0.23$ (Additional file 1, Figure S5). Overall heterogeneity was substantial, with $I^2=95.0\%$ ([95% CI, 91.9% to 96.9%], $Q_6=119.75$, $p<0.001$). Sensitivity analyses by type of design did not alter these results (Additional file 1, Figures S6–S8).

Psychopathology

Regarding the primary outcome of psychopathology, we excluded one study [78] from the data synthesis, because the data from this study was compared to that of another study conducted years earlier with a different sample [79]. Prior to the exclusion of this study, overall quality/risk of bias was identified as a significant moderator of the summary effect size, which was no longer the case after this study was excluded, suggesting that it introduced bias into the respective meta-analysis. The forest plot in Fig. 3 illustrates the individual and summary effect size estimates. The resulting pooled effect size of postline assessments ($n=10$ studies, $k=19$ estimates, $N=1629$) was SMD = 0.01 [95% CI, −0.17 to 0.37], $p=0.48$. Overall heterogeneity was substantial, with $I^2=98.3\%$ ([95% CI, 98.0% to 98.6%], $Q_{19}=1083.61$, $p<0.001$). Visual inspection of the corresponding funnel plots (Additional file 1, Figure S4) suggested no clear study bias, but the presence of one outlier [21].

Meta-regression analyses showed that differences in mean scores at baseline ($k=19$, $\beta=-0.10$, [95% CI, −0.16 to −0.05], SE = 0.03, $p<0.001$) and the study design ($k=19$, $\beta=-0.64$, [95% CI, −1.21 to −0.07], SE = 0.29, $p=0.03$) significantly moderated the individual effect size estimates. On average, effect sizes increased for patient groups with higher levels of psychopathology at baseline (relative to the other group, see Fig. 4) and tended to favour HT over IT when only RCTs were considered (Additional file 1, Table S7).

Table 1 Characteristics of the included publications. Studies referring to the same sample are clustered within sections; bolded studies were included in the meta-analysis

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Boege et al. (2014) [62] Germany	92	5–17 (13.7 ± 2.8)	49 (53.3%)	RCT	General psychiatric disorders	Short IT with early discharge and subsequent HT (Ø40.4 h with family), day services in the clinic could be used during HT, duration IT: 47.7 ± 28.8 days, duration HT: 109 days	IT, duration: 69.4 ± 30.7 days	K-SADS, CIS, HoNOSCA, CGAS, SDQ	Discharge	Some concerns
Boege et al. (2015) [19]								CGAS, costs in €	Discharge Follow-up (8 months)	Some concerns
Boege et al. (2015) [63]								K-SADS, CIS, HoNOSCA, CGAS, SDQ	Discharge	Some concerns
Kirchmann et al. (2014)) [64]								BesT	Discharge Follow-up (8 months)	Some concerns
Boege et al. (2021)) [65]								CGAS, HoNOSCA	Discharge Follow-up 1 (8 months), follow-up 2 (48 months)	Some concerns

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Henggeler et al. (1999) [38] USA	113	10–17 (12.9 ± 2.1)	39 (34.5%)	RCT	Psychiatric emergencies, general psychiatric disorders	Multisystemic Therapy (Ø97.1 h with family), no treatment elements in the clinic during HT, duration: 123.0 ± 29.0 days	Hospitalisation, duration: 5.8 ± 3.5 days	CBCL, PEI, DISC, GSI-BSI, FFS, FACES-III, LFSS	Discharge inpatient/discharge HT	Some concerns
Schoenwald et al. (2000) [66]								Service Utilisation Survey, Restrictiveness of Living Environments Scale, hospital records	Discharge inpatient/discharge HT	Some concerns
Henggeler et al. (2003) [67]								CBCL, DISC, GSI-BSI, FFS, FACES-III, Service Utilisation Survey	Discharge inpatient/discharge HT Follow-up 1 (6 months) Follow-up 2 (12 months)	Some concerns
Sheidow et al. (2004) [68]								Costs in $, CBCL, GSI	Discharge inpatient/discharge HT Follow-up 2 (12 months)	Some concerns
Huey et al. (2004) [69]								FFS, CBCL, GSI-BSI, YRBS	Discharge inpatient/discharge HT Follow-up 2 (12 months)	Some concerns

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Mattejat et al. (2001) [70] Germany	68	6–17 (11.1 ± 3.3)	24 (35.3%)	RCT	10 specified diagnoses (~ 15% of all inpatients treated in that clinic)	HT (intensity not described), approx. ¼ of contacts took place in the clinic during HT, duration: 120.9 days	IT, duration: 90.5 days	MSS, rating of psychosocial competency	Discharge Follow-up (44 months)	High
Remschmidt et al. (1988) [33]								MVL, CBCL, categorisation in improvement/no change/deterioration	Discharge	High
Remschmidt (1988) [34]								MVL, CBCL, 7-point Likert scale for psychosocial competence, treatment satisfaction	Discharge	High
Ougrin et al. (2018) [18] UK	106	12–17 (16.3 ± 1.6)	69 (65.1%)	RCT	General psychiatric disorders	Short IT with early discharge and subsequent supported discharge service including HT (SDS, intensity flexible, up to a maximum of daily contacts), day services in hospital could be used during HT, duration: 116.3 ± 70.1 days	IT, duration: 50.0 days	SDQ, CGAS, SHQ, ChASE; costs in £, Child and Adolescent Service Use Schedule	6 months post randomisation	Low
Ougrin et al. (2021) [71]								CIS, HoNOSCA, SHQ, CGI-I	6 months post randomisation	Low

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Reimer (1983) [22] Germany	62	8–12 (n/a)	13 (21.0%)	RCT	Not specified	HT (Ø38 contacts with family), no treatment elements in the clinic during HT, duration: 90.0 days	IT, duration: 90.0 days	AFS, PFK, conflicting behaviour between child and parent questionnaire (21 items), performance/social/anxiety questionnaire (39 items)	Discharge Follow-up (6 months)	Some concerns—high
Schmidt et al. (2006) [16] Germany	105	6–17 (11.0 ± 3.0)	36 (34.3%)	nRCT	General psychiatric disorders (no extreme rare diagnoses)	HT (Ø20 contacts with family, 3 contacts with relevant others), no treatment elements in the clinic during HT, duration: 105.0 ± 21.0 days	IT, duration: 105.0 ± 42.0 days	SGKJ, MEI, MAS, 7-point Likert scale for psychosocial functioning, 7-point Likert scale for changes in symptoms	Discharge Follow-up (13.7 months)	Moderate
Schmidt et al. (1998) [17]								Not reported	Discharge, preliminary data	Moderate
Winsberg et al. (1980) [21] USA	49	5–13 (9.4 ± 1.4)	8 (16.3%)	RCT	General psychiatric disorders (i.e. emotional and behaviour disorders)	Short IT with early discharge and subsequent HT (intensity not described), no treatment elements in the clinic during HT, duration IT: 7–21 days, duration HT: 177 days	IT, duration: 138.0 days	BRS, DCB, DESB, MAT, SESAT, PSS, FFC	Discharge	High

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Evans et al. (2003) [37] USA	238	5–18 (12.3 ± 3.6)	112 (47.1%)	RCT	General psychiatric disorders	Home-Based Crisis Intervention and Enhanced Home-Based Crisis Intervention (intensity not described), no treatment elements in the clinic during HT, duration: 4–6 weeks	Crisis Case Management, duration: 4–6 weeks	CAFAS, FACES-II, CBCL, Piers-Harris Children's Self Concept Scale	Discharge Follow-up (6 months)	Some concerns
Preyde, Frensch, et al. (2011) [40] Canada	169	6–18 (11.6 ± 2.8)	42[b] (24.9%)	nRCT	General psychiatric disorders	HT (~ 10 h per week), no treatment elements in the clinic during HT, duration: 157.5 ± 108.0 days	Residential treatment centres, 24-h facilities that are not licensed as a hospital but do offer supervision and mental health treatment programmes for children, duration: 234.0 ± 174.0 days	CAFAS, BCFPI	Discharge Follow-up 1 (12–18 months) Follow-up 2 (36–40 months)	Serious
Preyde, Cameron, et al. (2011) [72]								CAFAS, BCFPI, KINDL, FAD	Discharge Follow-up (12–18 months)	Serious
Cameron et al. (2011) [73]								CAFAS, BCFPI	Discharge Follow-up (12–18 months)	Serious
Preyde et al. (2010) [74]								CAFAS, BCFPI	Discharge Follow-up (12–18 months)	Serious
Frensch et al. (2009) [75]								CAFAS, BCFPI, KINDL	Discharge Follow-up (12–18 months)	Serious
Preyde et al. (2009) [76]								CAFAS, BCFPI	Discharge Follow-up (12–18 months), preliminary data	Serious

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Graf et al. (2021) [77] Switzerland	132	6–17 (13.7 ± 2.9)	71 (53.8%)	nRCT	General psychiatric disorders	HT (daily contacts except of weekends), no treatment elements in the clinic during HT, duration: 83.7 ± 28.0 days	IT, duration:100.8 ± 62.7 days	HoNOSCA, GAF, treatment satisfaction questionnaire	Discharge	Serious
Herpertz-Dahlmann et al. (2020) [78], **Herpertz-Dahlmann et al. (2014)** [79], for control group Germany	106	14–17 (15.2 ± 1.4)	106 (100%)	Independent samples	Anorexia nervosa	Short IT with early discharge and subsequent HT (Ø4.4 contacts per week during the first month), no treatment elements in the clinic during HT, duration IT: 53.2 ± 6.7 days, duration HT: 108.5 days	IT, duration: 102.2 days	EDI-2, MRAOS, BMI[c]	Discharge Follow-up (12 months)	Critical
Wilmshurst (2002) [80] Canada	65	6–14 (10.7 ± 2.1)	11[b] (16.9%)	RCT	General psychiatric disorders	HT (Ø48.3 ± 15.0 h), no treatment elements in the clinic during HT, duration: 90.0 days	Residential treatment centres, 24-h facilities that are not licensed as a hospital but do offer supervision and mental health treatment programmes for children, duration: 90.0 days	SCIS, SSRS	Discharge Follow-up (12 months)	High

Table 1 (continued)

	No. of patients[a]	Age range (*M* ± *SD*)	Female No. (%)	Study design	Diagnoses	HT condition (intensity), duration (*M* ± *SD*)	Control condition, duration (*M* ± *SD*)	Outcome measures	Endpoints	Risk of bias
Erkolahti et al. (2004) [81] Finland	490	3–13 (9.1 ± 1.66)	181 (37%)	nRCT	General psychiatric disorders	HT (not specified, ranged from once a week to once a month), day services in hospital could be used during HT, duration: not reported	IT, duration: not reported	CGAS	Discharge	Serious

Abbreviations: HT Home treatment, *IT* Inpatient treatment; *nRCT* non-randomised controlled trial, *RCT* Randomised controlled trial, *AFS* Angstfragebogen für Schüler, *BCFPI* Brief child and family phone interview, *BesT* Behandlungseinschätzung stationär-psychiatrischer therapie, *BMI* Body mass index, *BRS* Conners behaviour rating scale; *CAFAS* Child and adolescent functional assessment scales, *ChASE* Child and adolescent service experience, *CBCL* Child behaviour checklist, *YRBS* Youth risk behaviour survey, *CGAS* Children's global assessment scale, *CGAS* Children's global assessment scale, *CGI-I* Clinical global impression—Improvement scale, *CIS* Columbia Impairment scale, *DCB* Devereux child behaviour rating scale, *DESB* Devereux elementary school behaviour rating scale, *DISC* Diagnostic interview schedule for children, *EDI-2* Eating disorder inventory-2, *FACES-III* Family adaptability and cohesion evaluation scales, *FAD* Family assessment device, *FFC* Family functioning checklist, *FFS* Family friends and self scale, *GSI-BSI* Global severity index of the brief symptom inventory, *HoNOSCA* Health of the nations outcome scale for children and adolescents, *KINDL* Quality of life questionnaire, *K-SADS* Kiddie-schedule for affective disorders and schizophrenia, *LFSS* Lubrecht's family satisfaction survey, *MAS* Multiaxial classification scheme for psychiatric diseases in children and adolescents, *MAT* Metropolitan achievement test, *MEI* Mannheim parent interview, *MRAOS* Morgan and russell average outcome score, *MSS* Marburg symptom scale, *MVL* Marburger verhaltensliste, *PEI* Personal experiences inventory, *PFK* Persönlichkeitsfragebogen für kinder, *PSS* Psychiatric status schedule, *SCIS* Standardised client information system, *SDQ* Strength and difficulties questionnaire, *SDQ* Strengths and difficulties questionnaire, *SESAT* Stanford early school achievement test, *SGKJ* Global assessment scale for children and adolescents, *SHQ* Self-harm questionnaire, *SSRS* Social skills rating system

[a] Number of patients providing relevant data, dropouts excluded

[b] number of the study sample not reported and therefore estimated based on the study population; include dropouts throughout treatment

[c] outcomes that were assessed in both intervention and control group only

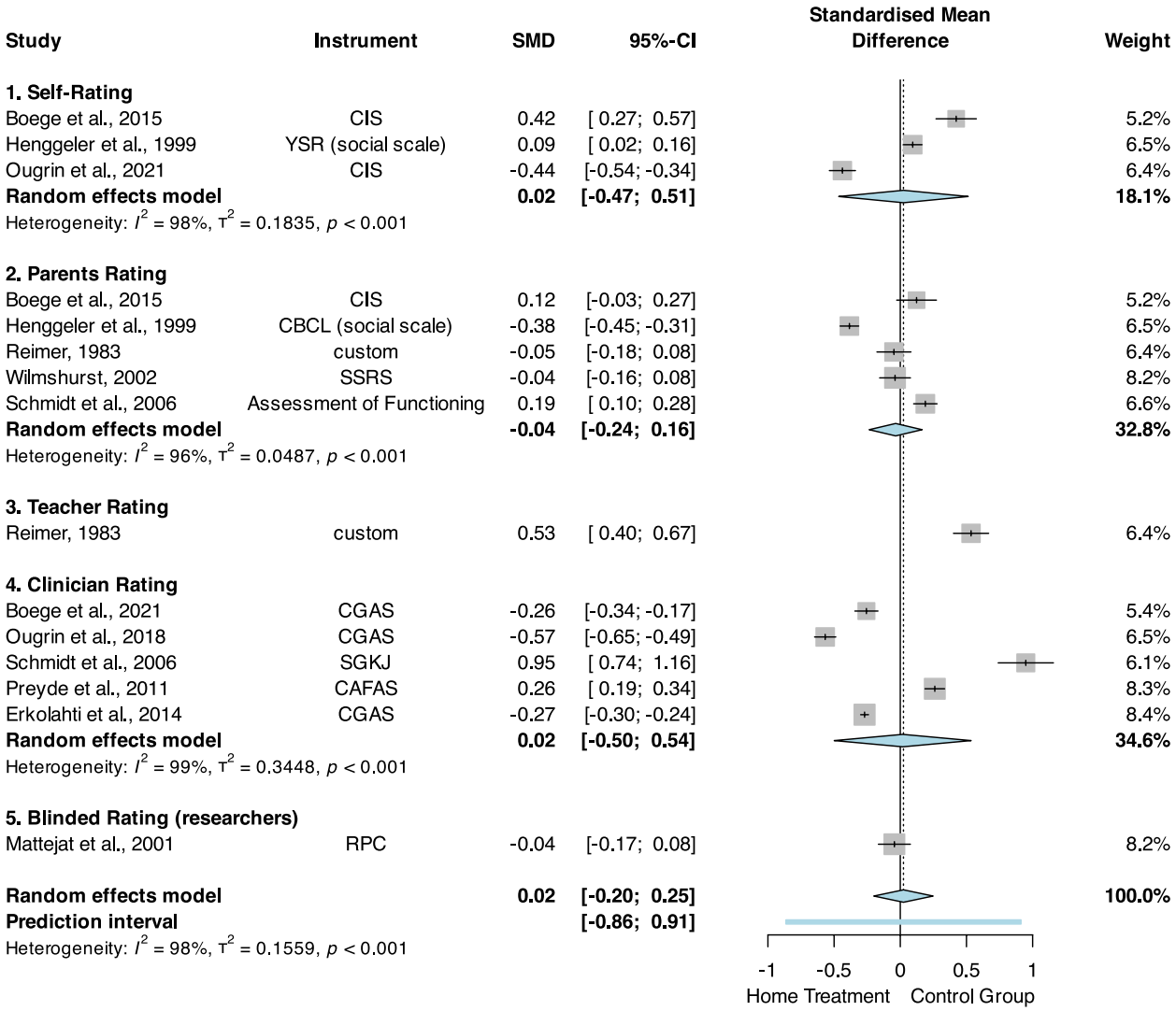

Fig. 2 Differences in pre- to post-treatment effects in psychosocial functioning scores. SMD, standardised mean difference; CAFAS, Child and Adolescent Functioning Assessment Scale; CBCL, Child Behaviour Checklist; CGAS, Children's Global Assessment Scale; CIS, Columbia Impairment Scale; RPC, rating of psychosocial competency; SGKJ, global assessment scale for children and adolescents ("Skala zur Gesamtbeurteilung von Kindern und Jugendlichen"); SSRS, Social Skills Rating System; YSR, Youth Self-Report

For follow-up assessments, the pooled effect size ($n=7$ studies, $k=9$ estimates, $N=749$) was SMD = 0.05 [95% CI, −0.18 to 0.27], $p=0.69$ (Additional file 1, Figure S9). Overall heterogeneity was substantial, with $I^2=95.8\%$ ([95% CI, 93.8% to 97.2%], $Q_8=192.09$, $p<0.001$).

Notably, one study [37] compared HT with another alternative for IT ("Crisis Case Management"), which met the formal inclusion criteria but differed substantially from the control condition we intended for comparison as no inpatient or residential care was involved. A sensitivity analysis excluding this study showed negligible differences from the overall meta-analysis (Additional file 1, Figures S10 and S11), as did a sensitivity analysis considering only RCTs (Additional file 1, Figures S12 and S13). When considering only nRCTs, the resulting pooled effect size of postline assessments ($n=2$ studies, $k=3$ estimates, $N=304$) was SMD = 0.62 [95% CI, 0.29 to 0.96], $p=0.002$ ($I^2=90.7\%$, [95% CI, 75.7% to 96.5%], $Q_2=21.55$, $p<0.001$; see Additional file 1, Figure S14); the result for follow-up outcomes did not change (Additional file 1, Figure S15).

Secondary outcomes

Regarding the treatment satisfaction, the pooled effect size ($n=4$ studies, $k=7$ estimates, $N=529$) was SMD = 0.08 [95% CI, −0.70 to 0.86], $p=0.84$. Overall

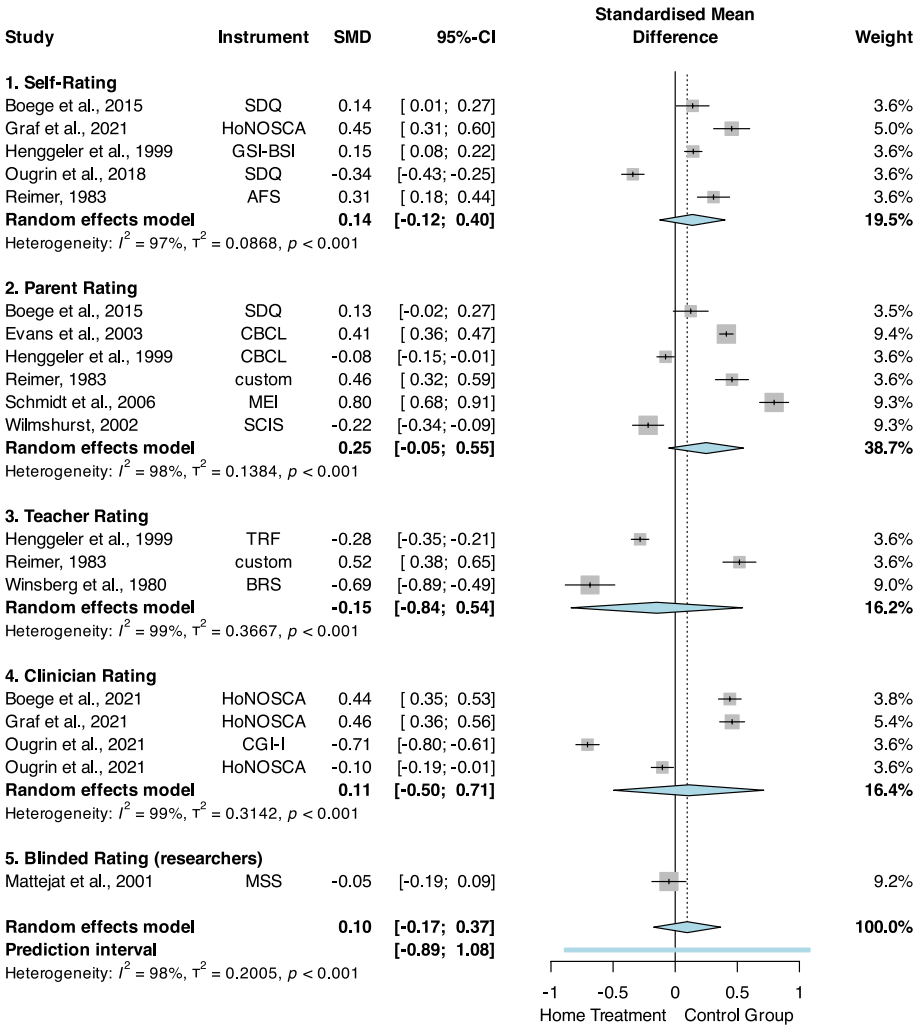

Fig. 3 Differences in pre- to post-treatment effects in psychopathology. SMD, standardised mean difference; AFS, anxiety questionnaire for pupils ("Angstfragebogen für Schüler"); BRS, Conners Behaviour Rating Scale; CBCL, Child Behaviour Checklist; CGI-I, Clinical Global Impression—Improvement scale; GSI-BSI, Global Severity Index of the Brief Symptom Inventory; HoNOSCA, Health of the Nations Outcome Scale for children and adolescent; MEI, Mannheim Parents Interview ("Mannheimer Eltern Interview"); MSS, Marburg Symptom Scale; SCIS, Standardised Client Information System; SDQ, Strength and Difficulties Questionnaire; TRF, Teacher Report Form

heterogeneity was substantial, with $I^2 = 99.0\%$ ([95% CI, 98.7% to 99.3%], $Q_6 = 606.61$, $p < 0.001$).

For treatment duration, the pooled effect size ($n = 5$ studies, $N = 491$) was SMD = −1.73 [95% CI, −3.92 to 0.46], $p = 0.12$. Overall heterogeneity was substantial, with $I^2 = 99.7\%$ ([95% CI, 99.6% to 99.8%], $Q_4 = 1356.38$, $p < 0.001$).

Regarding treatment costs, the pooled effect size ($n = 2$ studies, $k = 3$ estimates, $N = 290$, one study [68] was not considered due to inconsistent reporting) was SMD = −1.55 [95% CI, −4.56 to 1.46], $p = 0.313$. Overall heterogeneity was substantial, with $I^2 = 99.9\%$ ([95% CI, 99.8% to 99.9%], $Q_4 = 1559.47$, $p < 0.001$).

For readmission rates, the pooled effect size ($n = 3$ studies, $k = 3$ estimates) was OR = 1.27 (95% CI, 0.74 to 2.18, $p = 0.39$) with no significant heterogeneity observed ($I^2 < 0.01\%$, $Q_2 = 1.60$, $p = 0.45$). Forest plots for all secondary outcomes are provided in Additional file 1, Figures S16–S19.

Non-inferiority testing

The systematic search for the efficacy of conventional IT for youth with mental disorders yielded two studies [82, 83]. The resulting SMD was 0.64 [95% CI, 0.60 to 0.68] for psychosocial functioning ($n = 1$ study, $k = 1$ estimate, $N = 150$) and 0.27 [95% CI, 0.08 to 0.46] for

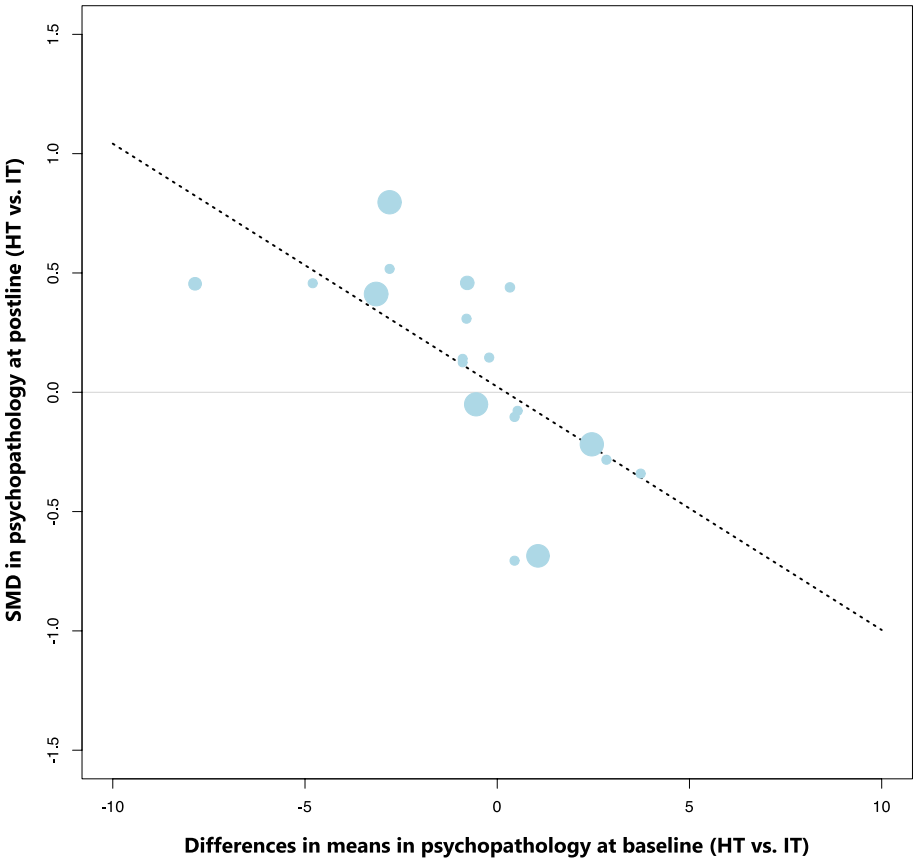

Fig. 4 Meta-regression scatterplot showing the association between baseline differences in means in psychopathology and standardised mean differences (SMD) at postline. Positive delta scores indicate higher baseline psychopathology in the HT group compared to the IT group; negative SMD favour HT at postline

Table 2 Results of the non-inferiority testing

Outcome	Endpoint				Objective non-inferiority margin			
	SMD_{Inptr}	[95% CI]	$SMD_{HTvsInpt}$	[95% CI]	$\Delta_{50\%}$	$\Delta^{MAX}{}_{50\%}$	$\Delta_{95\%}$	$\Delta^{MAX}{}_{95\%}$
Psychosocial functioning	0.64	0.60; 0.68	− 0.06	− 0.29; 0.16	1.25	1.21	1.02	1.02
Psychopathology	0.27	0.08; 0.46	− 0.03	− 0.29; 0.24	1.92	1.48	1.07	1.04

Abbreviations: SMD_{Inptr} Standardised mean difference between IT and untreated control per primary outcome, $SMD_{HTvsInpt}$ Standardised mean difference between HT and IT per primary outcome based on RCT studies, $\Delta_{50\%}$ *and* $\Delta^{MAX}{}_{50\%}$ Non-inferiority margins (50% of the effect of conventional psychiatric IT, according to the value of SMD_{Inptr}, and of its 95% CI upper bound, respectively), $\Delta_{95\%}$ *and* $\Delta^{MAX}{}_{95\%}$ non-inferiority margins corresponding to 95% of the effect of conventional psychiatric IT, according to the value of SMD_{Inptr}, and the value of its 95% CI upper bound, respectively

psychopathology ($n=1$ study, $k=2$ estimates, $N=132$). The calculated objective non-inferiority margins for each primary outcome are shown in Table 2, along with the SMD between HT and IT for each primary outcome based on RCT studies.

Evidence of non-inferiority of HT was obtained for both primary outcomes of psychosocial functioning and psychopathology. First, conventional IT resulted in a significant improvement in the primary outcomes compared with no treatment (waitlist controls). Second, regardless of the non-inferiority margin used (i.e. 50% or 95%; based on SMD_{Inptr} or the respective upper bound of the 95% CI), HT appeared to be non-inferior to conventional IT. Figure S20 in Additional file 1 illustrates the results of the non-inferiority assessment and Figures S21 and S22 show the forest plots based on the non-inferiority analysis.

Discussion

The aim of this meta-analysis was to synthesise the existing data on the effectiveness of HT as an alternative to IT for youth with mental disorders. Based on a comprehensive synthesis of 30 articles (18 providing relevant data) derived from 13 non-overlapping samples with a total of 1795 individuals, we examined differences in treatment outcomes including potential moderators.

Our analyses for both superiority and non-inferiority testing showed no significant postline differences between patients who received HT and those who received IT with respect to the primary outcomes psychosocial functioning and psychopathology. This finding is consistent with conclusions drawn in several previous reviews of the existing data, suggesting that HT is generally not less effective than conventional IT [24, 27, 28].

The mean difference between groups at baseline was identified as a significant moderator of post-treatment psychopathology: on average, patient groups with higher levels of psychopathology at baseline (relative to the other group) showed greater improvements in the postline outcome (expressed as a higher SMD). Both IT and HT appear to be particularly effective for patients with severe psychopathological burden, for whom both services are designed. Alternatively, this effect may also reflect a regression to the mean as patients presenting with higher levels of psychopathology at baseline presumably had greater potential for improvement during treatment compared to those with lower baseline levels. Study design moderated post-treatment psychopathology, with effect sizes favouring HT over IT when only RCTs were considered and sensitivity analysis with only nRCTs showed significantly better psychopathology outcomes at postline for IT. This emphasises the importance of using rigorous methodological approaches in evaluation studies. In RCTs, treatments are usually delivered according to a strict protocol, ensuring high treatment fidelity. HT, as implemented in RCTs, might be more standardised and thus more effective compared to more variable programmes in less controlled study designs. Besides, patients who participated in RCTs may have hoped to be assigned to the HT group. Their disappointment when randomised to the control group may have affected their expectations of treatment, which has been associated with negative treatment outcome [84]. However, given the modest number of studies included in the meta-regression analyses and their exploratory nature, these findings should be considered indicative rather than conclusive and should be interpreted with caution, highlighting areas where further research is needed to support them. Despite the expectation that HT would be less expensive because of the reduced reliance on clinic infrastructure and staff, we found no significant difference in treatment costs between HT and IT. Possible explanations include the hospitalisation of some patients during the course of the HT and the fact that certain HT programmes compensated for lower intensity with longer treatment duration. However, the total duration of treatment was not significantly different between the two modalities. Furthermore, and contrary to expectations, readmission rates after discharge did not differ significantly between the two treatment settings. These findings do not support the expectation that HT is a cheaper alternative and leads to fewer readmissions due to a better transfer of treatment gains after discharge in HT.

However, the conclusions drawn from these findings are limited by the small sample sizes, with only two studies included in the meta-analysis of treatment costs [18, 19] and three studies in the meta-analysis of readmission rates [65, 71, 78]. A direct comparison of the overall cost-effectiveness of the two treatments was not possible due to insufficient data.

This meta-analysis adheres to several aspects of good practice, including the pre-registration of a review protocol, considerable effort to obtain all available data (including contacting interlibrary loan, antiquarian booksellers, and authors of all studies), double-rated data extraction by two independent reviewers, and the use of objective non-inferiority testing for primary outcomes.

However, our findings should be viewed in the context of several limitations, concerning both our methodology and the existing body of literature. We found considerable statistical heterogeneity in all results, reflecting our broad interpretation of the term "home treatment". In nine studies, HT completely replaced hospitalisation [16, 21, 22, 37, 38, 40, 70, 77, 80], while in the other four, it only reduced the length of hospital stay [18, 62, 78, 81]. Moreover, while most studies strictly separated the home and clinical environments, some provided additional day services during HT. These included distinct treatment elements such as structured daily routines, group therapy and opportunities for bonding with other patients, which have also been reported as important in the treatment of children and adolescents with psychiatric disorders [85, 86]. The intensity of HT also varied widely, ranging from a maximum of 12 h per week [80] to a minimum of one visit per month [81], and while most programmes addressed general psychopathology, two targeted specific diagnoses [33, 78]. Inconsistencies between studies in the selected outcomes and the instruments used to measure them may have introduced additional heterogeneity into the results, as may the combination of RCTs and nRCTs, which could also have affected the overall null effect. Although we conducted sensitivity analyses by types of design, these results should be interpreted with caution

due to the small number of studies per subgroup. Besides, the generally small number of individual studies for the meta-regression analyses should also be noted. Meta-regression models can be overfitted when the number of studies per covariate examined is small, which may lead to spurious associations between covariates and treatment effect due to data idiosyncrasies [60]. Thus, these analyses need to be considered exploratory and interpreted with caution. For psychosocial functioning, only nine studies were included, which is below the minimum of 10 as suggested in the Cochrane Handbook [87]. However, there is also evidence that the required number of observations per covariate in ordinary least squares linear regression might be considerably lower than 10 [60]. We chose to explore potential moderators for effect size in this outcome, as such analyses can provide important information about directions for future research.

In terms of the search strategy, restricting our search to PubMed, CINAHL, PsychINFO, and Embase may have led to the omission of some relevant studies. The search results were screened by a single rater only with a second-rater screening for a random 10% sample to test the robustness of the process. The decision for inclusion or exclusion was in complete agreement; however, this approach leaves an increased risk of overlooking relevant studies in the remaining search results.

Regarding the available evidence, the small number of eligible studies, many of which used small samples, limited the statistical power, especially for secondary outcomes not reported in all studies. This made it impossible to further specify the treatment characteristics of the included HT to reduce heterogeneity. The moderate to high risk of bias in twelve out of thirteen studies indicates an overall low study quality. Additionally, the diversity of the studies, spanning four decades and six countries (all located in Europe and North America) with different legal and financial frameworks, as well as varying IT quality, limits the generalisability of our findings to other healthcare systems. Most studies did not explore potential mechanisms underlying the effectiveness of HT, such as the involvement of the whole (family) system, and left open the question of which family situations and diagnostic patterns are more likely to benefit from HT.

To address these limitations and replicate the current findings, further research on HT in child and adolescent psychiatry, as well as meta-analysis of its results as more studies are published, is urgently needed. Future studies should consider some important aspects: to ensure standardised treatment designs in future studies, it is advisable to refer to current guidelines, such as the agreed minimum requirements proposed by Keiller et al. [35]. Moreover, we suggest focusing on a set of key constructs including psychosocial functioning, psychiatric symptoms, quality of life, family functioning, and patient satisfaction to streamline the diversity in outcome measures. For consistent and comparative measurement, researchers may consult current reviews of widely used, reliable and validated instruments (e.g. Kwan and Rickwood [88] or the International Consortium for Health Outcomes Measurements [89]). Cost-effectiveness of new programmes should not only consider direct treatment costs, but also subsequent psychiatric care, such as inpatient readmissions, emergency department visits, medication, and outpatient treatments post-discharge. Quantifying the contacts with patients, families, peers, and schools during the HT could help understanding the potential mechanisms underlying its effectiveness and to explore the influence of systemic and individual factors in presenting disorders. Our study also highlights the importance of stringent methodological designs in treatment evaluation. This involves the use of randomised control groups and assessments at multiple time points (pre-, post-treatment, and follow-up), executed by trained and blinded researchers. If randomisation is difficult to realise due to health economic factors like imbalances in treatment group capacities, adaptive randomisation plans might be considered.

However, adhering to these methodological standards often requires additional resources, such as research staff or strategies for handling patient allocation disparities. Therefore, we call upon policymakers to not only endorse future HT projects in clinical practice but also support their scientific evaluation.

Conclusions

In this meta-analysis, we found no evidence that HT is generally less effective than conventional IT. Both treatments appear to be particularly effective in patients with a high psychopathological burden, highlighting the potential of HT as an effective alternative to IT in child and adolescent psychiatry. However, the generalisability of these findings is restricted by various limitations in the existing literature, and several unanswered questions remain. Further research is needed to identify patients who are more likely to benefit from HT based on their family situation and diagnosis patterns.

Abbreviations

CI	Confidence interval
HT	Home treatment
HBCI	Home-based crisis intervention
IT	Inpatient treatment
MST	Multisystemic therapy
nRCT	Non-randomised controlled trial
OR	Odds ratio
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
RCT	Randomised controlled trial

REML	Restricted maximum likelihood estimator
ROB2	Cochrane collaboration risk of bias 2.0
ROBINS-I	Risk of bias in non-randomised studies – of interventions
SE	Standard error
SMD	Standardized mean difference

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12916-024-03448-2.

Supplementary Material 1: Table S1. PRISMA 2020 Checklist. Table S2. Detailed search strategy. Table S3-S5. Grouping of different instruments. Table S6. Listing of all data derived by calculation. Figure S1. Additional systematic search on the efficacy of Inpatient Treatment. Figure S2 & S3. Summary of the risk of bias of RCTs and nRCTs. Figure S4. Funnel plots of individual observed effect sizes. Table S7. Meta-regression results. Figure S5. Follow-up effects in psychosocial functioning. Figure S6-S8. Sensitivity analyses for psychosocial functioning, including only RCTs or nRCTs. Figure S9. Follow-up effects in psychopathology. Figure S10 & S11. Sensitivity analyses for psychopathology excluding the study of Evans et al. (2003). Figure S12-S15. Sensitivity analyses for psychopathology, including only RCTs or nRCTs. Figure S16-S19. Meta-analyses of secondary outcomes. Figure S20-S22. Meta-analyses based on non-inferiority assessments.

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Authors' contributions
MK, JK, and DG conceptualised the study. CS, JK, and DG designed the methodology. DG collected the data. CS did the data analysis. DG prepared the original draft of the manuscript with the input of CS, MC, and IB and with supervision of MK and JK. All authors edited and reviewed the final manuscript. DG and CS had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript and had responsibility for the decision to submit for publication.

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Availability of data and materials
The underlying dataset and analysis code used in this article [90] are available without restrictions on the Open Science Framework (osf.io) and can be found here: https://doi.org/10.17605/OSF.IO/TFD2Q.

Declarations

Declarations
Ethics approval and consent to participate.
Not applicable.

Consent for publication
Not applicable; this manuscript does not include any details, images, or videos relating to an individual person.

Competing interests
All authors declare that they have no potential or actual conflict of interest.

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Publisher's Note

Appendix B

Treatment outcome of an intensive psychiatric home treatment for children and adolescents: a non-randomized controlled pilot evaluation.

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ORIGINAL CONTRIBUTION

Treatment outcome of an intensive psychiatric home treatment for children and adolescents: a non-randomized controlled pilot evaluation

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Abstract
Home treatment (HT) may offer an effective and cost-efficient alternative to inpatient treatment for children and adolescents with acute mental disorders. This study introduces and evaluates a pilot HT project from Bern, Switzerland, with HT completely replacing an inpatient treatment. A total of $n = 133$ children and adolescents with acute mental disorders and inpatient treatment needs were treated either in the new HT program ($n = 37$) or in an active control group with inpatient treatment as usual (I-TAU, $n = 96$). Psychopathological burden was assessed by the Health of the Nation Outcome Scale for Children and Adolescents clinician-rated (HoNOSCA) and self-rated (HoNOSCA-SR) at the time of admission and at discharge. Treatment effects were assessed and compared using Augmented Inverse Probability Weights to adjust for baseline differences and to control for treatment duration. Participants ranged in age from 6 to 17 years ($M = 13.71$ years, $SD = 2.93$), 54% were female. HT resulted in significant improvements in the HoNOSCA ($d = 0.79$, $p < .001$) and HoNOSCA-SR ($d = 0.63$, $p = .006$). No significant differences on treatment effects were observed between HT and the reference group I-TAU in the HoNOSCA ($d = 0.01$, $p = .96$) or the HoNOSCA-SR ($d = 0.11$, $p = .63$). Overall, results indicate HT to be an effective alternative for children and adolescents with acute mental health disorders instead of hospitalization. Further evaluation with random group allocation and long-term follow-up should attempt to replicate and extend the current findings.

Keywords Home treatment · Treatment setting · Therapy research · Children and adolescents · Child and adolescent psychiatry

Introduction

Mental health disorders in children and adolescents are associated with substantial impairments in various aspects of psychosocial functioning and quality of life [1]. Based on longitudinal data from a large epidemiological sample, Caspi et al. [2] reported that 59% of all participants met criteria for a mental disorder by age 18. In addition, 69% of those who met criteria for at least one mental disorder at age 45 received their first diagnosis by age 18, indicating the particular need for mental healthcare in children and adolescents [2, 3]. Despite the apparent need for treatment services in this age group, children and adolescents with mental health disorders in Switzerland [4], and many other parts of the world [5–7], have impeded access to appropriate and intensive care including inpatient treatment. To address the challenge of an increasing demand for intensive mental healthcare among youth, there is growing interest in developing alternatives that are less costly, yet not less effective than inpatient treatment.

One treatment modality discussed as a promising alternative to conventional inpatient treatment is home treatment (HT) for children and adolescents with mental disorders [8, 9]. HT offers the opportunity to conduct intensive child and

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adolescent psychiatric treatment using the infrastructure and supervision of the respective family or caregivers. Thus, HT requires fewer resources than inpatient treatment, and allows to strongly involve the patient's living environment in therapy, which is proposed to reduce the risk of failed transfer of treatment achievements after discharge [10]. The exact operationalization of HT differs across studies, with HT either supplementing and shortening an initial inpatient stay or replacing it entirely. Boege et al. [11] who conducted a randomized controlled trial with HT supplementing hospitalization with $n = 100$ children and adolescents in Germany, reported significant clinical improvements 8 months after the treatment in both the HT and inpatient control group without any group differences. Economic efficiency was significantly better in the HT group [12]. A recent study from the Netherlands also conducted HT supplementing a short hospitalization, and the symptom load of the $n = 112$ participants decreased by over 50% [13]. In a German study ($n = 105$) comparing sole HT to inpatient treatment, Schmidt et al. [14] found that treatment effect was superior in the inpatient group directly after treatment but patients in the HT group showed a more stable maintenance of the treatment effects at 1-year follow-up. Reanalyzing two dissertations from the early 1990s, Mattejat et al. [15] found that there was no difference between the HT and the inpatient control group ($n = 68$) concerning the course of marked psychiatric symptoms and adaptation in school or work after almost four years. Similar results were obtained by Henggeler et al. [16], who investigated the effectiveness of home-based Multisystemic Therapy (MST) in comparison to an inpatient control group ($n = 113$). MST showed better results in a wide range of outcomes, including youth and family functioning [16], fewer mean days of hospitalization and shorter duration of inpatient stay [17] and reduced rates of suicide attempts after one year [18].

Building on this pioneering and promising work, the University Hospital of Child and Adolescent Psychiatry and Psychotherapy (CAP) Bern developed and implemented the HT program "AT_HOME" in May 2019 as an alternative to conventional inpatient treatment [19]. The aim of the program is to establish a new and equally effective treatment service for children and adolescents with acute mental health disorders while reducing treatment costs. Unlike most of the current HT programs reported in the literature, AT_HOME completely replaces an inpatient stay rather than supplementing it. The present pilot data that were obtained for quality assurance of the AT_HOME implementation aimed to compare the treatment outcomes of AT_HOME with conventional inpatient treatment at the CAP.

Materials and methods

The data presented were derived from a regular quality assurance process, which has been established at the CAP in Bern to evaluate the implementation of AT_HOME. The retrospective use of this data for research purposes was approved by the respective institutional review board (BASEC number: REQ-2020–00546).

Population and recruitment

Patients included in the analyses were children and adolescents with acute mental disorders who were treated between May 1, 2019 (earliest admission) and July 20, 2020 (latest discharge) either in one of the inpatient units or in the AT_HOME program, both at the CAP Bern. All participants were between 6 and 17 years of age at the time of treatment, living in the canton of Bern in Switzerland, and presented with a mental disorder that resulted in an explicit referral to inpatient treatment.

Patients were included in the AT_HOME program if they lived in a stable housing situation within a 30-min catchment area of the CAP, were able to speak and understand German language, and if written informed consent for participation was obtained from parents and patients over 13 years of age. Exclusion criteria were the presence of acute and severe child welfare hazards in the patient's household and acute endangerment to self or others that required immediate protection. At first consultation, all patients referred to the CAP for inpatient treatment between May 1, 2019 and May 1, 2020 who met inclusion criteria ($n = 71$) were introduced to the AT_HOME program, and were informed about the possibility to participate in this new treatment program. Interested patients and their families were provided with detailed information about the program and its structure. Subsequently, patients had the opportunity to choose between HT or standard inpatient treatment. Thirty-four patients/families (47.9%) who met the inclusion criteria decided against treatment in AT_HOME. Main reasons cited by parents for refusal were "the family feels overwhelmed" and "stressful family conflicts". Main reasons given by patients for refusal were "I need distance from the family" and "I believe that I can make faster progress in treatment in the clinic". A total number of $N = 133$ patients were treated in the defined time period either in AT_HOME ($n = 37$) or in one of the inpatient units of the CAP ($n = 96$). There was one drop out in the AT_HOME sample with a patient prematurely leaving treatment after an aggressive act against a member of the treatment team. All available data were considered for our intention-to-treat analyses.

Due to the retrospective nature of the present study, no a priori power calculation was conducted. However, sensitivity power analyses were carried out to allow post-hoc justification of sample sizes used for this manuscript. With the error probability α set to 0.05 and the predefined sample size of $n_1 = 37$ and $n_2 = 96$, a medium difference between groups of $d = 0.54$ can be assumed to be found with a power of $1 - \beta = 0.8$ (two tailed testing).

Therapeutic interventions

Patients were treated in one of two different treatment conditions (further detailed in Sects. Home Treatment (AT_HOME) and Inpatient treatment as usual (I-TAU), respectively): one group received HT at their residence while the other group received inpatient treatment as usual (I-TAU) in an inpatient unit of the CAP. Irrespective of the condition, all patients completed an intensive psychiatric and psychotherapeutic treatment, which included the support of different health care professionals (i.e., medical doctors, clinical psychologists, social educators and social workers and specialist nurses) and multimodal specialized therapies (e.g., skills training, resource activation, etc.). Based on the overall approach to therapy within the University Hospital, progress of therapy and individual as well as systemic treatment goals were defined according to principles of shared decision-making between patients, caregivers, and therapists in both settings. The goals were clinically monitored thereafter in the form of team meetings (without patients and caregivers) and weekly rounds with the team and patients in the inpatient units and team, patients, and caregivers in AT_HOME.

Home treatment (AT_HOME)

The AT_HOME program involves an intensive and inpatient-equivalent form of outreach treatment for children and adolescents aged 6–17 years with acute mental disorders and is financed in part by the health insurance companies and in part by the canton of Bern. Instead of a hospitalization, HT-patients were visited by a member of the treatment team at least once (if needed several times) a day with sessions lasting between 60 and 120 min. On Sundays, the physical contact was often replaced by a telephone call. A maximum of 10 patients and their family could be treated concurrently. Meetings usually took place in the patients' homes, but could also be arranged at other involved locations such as the patient's school or workplace. In addition, all families were provided with an acute crisis management phone number where a member of the AT_HOME team could be contacted 24 h/7d. Similar to inpatient treatment, patients received multidisciplinary child and adolescent psychiatric care. Therapy components were closely aligned with those of inpatient treatment and included all interventions that contributed to the reduction of symptoms and improvement of the patient's and system's functioning levels. Somatic examinations such as blood sampling or ECG formed also part of the AT_HOME treatment as in I-TAU, but also took place at the patient's home. Different from inpatient treatment, family members, confidants, and other key individuals (e.g., teachers) were intensively involved in both the treatment and the care of the patients, and patients continued their lives within their families and regular schools. The AT_HOME treatment team cooperated closely with the emergency unit of the CAP so that patients could be hospitalized immediately in the event of acute suicidal tendencies, if 24-h surveillance was required. In the event of an emergency hospitalization, the AT_HOME team continued as the respective treatment team and accompanied the patient during the stay in the emergency unit for a maximum of three days. In case of a longer hospitalization in the emergency unit, the participant was considered a drop-out of AT_HOME. However, this situation did not occur during the pilot evaluation. A suicide attempt was considered a criterion for discontinuation of AT_HOME, as this form of treatment could not provide the intensive surveillance of the patient required in this case. Again, this situation did not occur during the pilot evaluation. Contrary to I-TAU, the duration of treatment in AT_HOME was limited to 3–4 months.

Inpatient treatment as usual (I-TAU)

In the I-TAU group, participants received inpatient treatment on one of five inpatient units at the CAP Bern. The CAP Bern is one of Switzerland's largest institutions for child and adolescent psychiatry and psychotherapy providing mental healthcare for minors within a population of more than one million inhabitants. For the duration of therapy, patients in I-TAU lived with other children and adolescents in their respective unit, participated in the routine clinical program, activities and therapies, and attended the clinic school. Staff was present at any time around the clock, and the duration of treatment was not limited. A descriptive comparison between the treatment conditions is given in Table 1.

Outcome variables and endpoints

Assessments were conducted in both AT_HOME and I-TAU as part of the clinic's quality assurance process. At the time of admission (baseline) and the end of the treatment (postline), the *Health of the Nation Outcome Scale for Children and Adolescents* (HoNOSCA) [20] was assessed for all patients by clinician ratings and for adolescents ≥ 12 years of age additionally by self-rating (HoNOSCA-SR) [21]. The HoNOSCA is designed to cover a range of behavioral, symptomatic, social, and impairment domains and provides

Table 1 Differences and commonalities between treatment conditions

		AT_HOME	I-TAU
Differences	Setting	Patient at home in family, school, everyday life	Patient in the clinic and clinic school
	Care	At least one visit per day, emergency contact available 24 h/7d	Clinic staff available 24 h/7d
	Duration	Max. 3–4 months	No temporal limitation
	Focus	Patient-environment interaction	Patient
	Inclusion of caregivers	Almost daily family meetings	Weekly family meetings
	Frequency of different treatment components…		
	–Individual therapy with patient	2 / week by psychotherapists	1–2 / week by psychotherapists
	–Individual therapy with caregiver	1 / week by psychotherapists	1 / one to two weeks by psychotherapists
	–Group therapy	–	1 / week by psychotherapists
	-Supportive therapy like empowerment, social competencies training, skills training etc	2–3 / week by social educators and specialist nurses	3–4 / week by social educators and specialist nurses
		AT_HOME	I-TAU
Commonalities	Treatment components	Therapy components comprising interventions to reduce symptoms and improve patient's and system's functioning level	
	Target group	Patients aged 6–17 years presenting with a mental disorder that resulted in an explicit referral to inpatient treatment	
	Treatment team	Medical doctors, clinical psychologists, social educators, and specialist nurses	

a global outcome for psychopathology in the clinical setting. The scale consists of 13 items answered on a 5-point Likert scale (0 = "not at all" – 4 = "most severe problem"); thus, a higher sum score indicates higher levels of problems present. Clinicians who assessed the HoNOSCA received periodic training to ensure the reliability of the assessment, but were not blinded to treatment condition. Assessments of the HoNOSCA were conducted by four clinicians in the HT group and 17 clinicians in the I-TAU group. Psychometric properties were not calculated in the present study but have been shown to be acceptable in previous studies [21, 22]. Psychosocial functioning was assessed at the time of admission using the *Global Assessment of Functioning Scale* (GAF) [23, 24], which also showed acceptable interrater-reliability in the clinical work with children and adolescents [25]. The GAF is coded on a scale from 1 (no functioning at all) to 100 (perfect functioning). *Functioning* refers to an individual's ability to manage daily life with all social and role-related responsibilities. Treatment satisfaction was assessed after completion of the treatment by an independent research institute ("B&A – Beratungen und Analysen"; Consulting and Analyses, Bern) with a questionnaire designed by the CAP to assess treatment satisfaction on six different scales. Patients aged 12 years and older and parents of all patients were asked how much they agreed with various statements including "Overall, I am satisfied with the treatment" or "I would recommend the treatment to others" on a 5 point Likert scale ranging from 1 = "not at all satisfied" to 5 = "absolutely satisfied". Thus, higher scores indicate higher levels of satisfaction. The items on the questionnaire were subsumed into six subscales: "Satisfaction with… 1. Initiation phase, 2. Information and transparency, 3. Treatment phase, 4. Team, 5. Completion phase, and 6. Treatment benefit." The psychometric characteristics of this questionnaire have not been investigated in previous studies. The internal consistency of the satisfaction questionnaire was very high, with Cronbach's $\alpha = 0.96$ for the patient questionnaire and $\alpha = 0.95$ for the parent questionnaire. The questionnaire in AT_HOME differed slightly from the I-TAU original as some questions about inpatient treatment could not be adapted for HT, such as satisfaction with the menu. In addition, patient and treatment characteristics such as age, gender, clinical diagnosis, and the duration of treatment were drawn from the patients' medical records.

Data analyses

In case of homogenous variances between AT_HOME and I-TAU, two-tailed two sample *t* tests were used to investigate group differences for dimensional demographic and clinical variables as well as baseline data, otherwise Welch's test was conducted. Fisher's exact test was applied to test group differences for categorical variables. Paired *t* tests were used to compare baseline and postline scores within groups. To compare the two treatments, the average treatment effect was calculated using the propensity score method of Augmented

Inverse Probability Weights (AIPW) to adjust for baseline differences between AT_HOME and I-TAU that may have occurred due to the lack of randomization in the recruitment process. AIPW estimators compute the averages of the augmented inverse-probability weighted outcomes for each level of treatment. In a first step, a probit model was employed to predict the treatment group as a function of demographic and baseline data. The parameters of the model were used to compute the inverse probability weight of each patient for assignment to his or her treatment condition. In a second step, linear regressions were employed to model the treatment-specific predicted outcome for each patient, using the baseline data as predictors and controlling for the treatment duration. In a final step, the weighted means of both treatment groups were calculated using the former computed inverse probability weights. The difference of these means represents the average treatment effect. All analyses were conducted in Stata/SE 16.1 except for sensitivity power analyses which were conducted in G*Power v3.1. A p value < 0.05 was defined as criteria for statistical significance.

Results

Sample characteristics

Of the $N = 133$ patients that were included in the analyses, $n = 37$ patients (16 females) were treated in AT_HOME and $n = 96$ (56 females) in I-TAU. Descriptive statistics of demographic and clinical data as well as baseline characteristics for both groups are depicted in Table 2. No significant group differences regarding sex, age, and HoNOSCA score were found. Significant group differences were found for the GAF score (AT_HOME < I-TAU), the HoNOSCA-SR score (AT_HOME < I-TAU), and distribution of the principal diagnoses.

Table 2 Demographic and baseline data of the two treatment groups and the total sample, with means and standard deviations (if not otherwise indicated), and comparison between the two groups

	AT_HOME	I-TAU	Total sample	Test statistics
Age (*mean* ± *SD*)	13.65 ± 2.75	13.73 ± 3.01	13.71 ± 2.93	$t_{131} = -0.14$, $p = .89$
GAF (*mean* ± *SD*)	40.84 ± 8.14	46.08 ± 10.27	44.41 ± 9.91	$t_{114} = 2.73$, $p = .01$
HoNOSCA (*mean* ± *SD*)	20.65 ± 7.18	21.43 ± 6.45	21.21 ± 6.65	$t_{130} = 0.61$, $p = .55$
HoNOSCA-SR (*mean* ± *SD*)	14.04 ± 8.69	21.9 ± 9.88	19.72 ± 10.52	$t_{75} = 3.4$, $p < .01$
Principal diagnoses (ICD-10)[a]; *n* (%)				$\chi^2_{6,\, n = 133} = 19.47$, $p < .01$
F1	0	2 (2.08%)	2 (1.5%)	
F2	1 (2.7%)	5 (5.21%)	6 (4.51%)	
F3	5 (13.51%)	29 (30.21%)	34 (25.56%)	
F4	20 (54.05%)	16 (16.67%)	36 (27.07%)	
F6	2 (5.41%)	6 (6.25%)	8 (6.02%)	
F8	3 (8.11%)	16 (16.67%)	19 (14.29%)	
F9	6 (16.22%)	22 (22.92%)	28 (21.05%)	

[a]For a translation of the ICD-10 codes into DSM-5 diagnoses, see DSM-5, Classification section [26, p. xiii ff]

Table 3 Mean and standard deviation of the postline data (columns t_1) and difference to baseline ($t_0 - t_1$) split by setting. Effect sizes are depicted as Cohen`s d

	AT_HOME sample				I-TAU sample			
	n[a]	t_1	t_0—t_1	Effect	n[a]	t_1	t_0—t_1	Effect
HoNOSCA	37	15.27 ± 8.03	5.38 ± 6.84	$d = 0.79$, $t = 4.79$, $p < .01$	95	13.68 ± 6.02	7.75 ± 6.11	$d = 1.27$, $t = 12.35$, $p < .01$
HoNOSCA-SR	23	10.39 ± 7.98	3.78 ± 5.98	$d = 0.63$, $t = 3.04$, $p < .01$	44	13.25 ± 9.36	9.36 ± 9.9	$d = 0.95$, $t = 6.27$, $p < .01$

[a]Cases without missing

Treatment effects

Pre–post effects of treatment

The descriptive postline statistics for AT_HOME and I-TAU are illustrated in Table 3. Within the two groups, both the HoNOSCA and the HoNOSCA-SR scores decreased significantly, represented by medium to large effect sizes.

Comparison of treatment

On average, patients in AT_HOME had a shorter treatment duration than in I-TAU (83.73 ± 27.97 days in AT_HOME vs 100.76 ± 62.70 days in I-TAU; $t_{128.2} = 2.16$, $p = .04$). Controlling for treatment duration, no significant difference was observed in the average treatment effect between AT_HOME and the reference group I-TAU in the HoNOSCA with patients in AT_HOME having an average value of 13.67 and patients in I-TAU of 13.62 ($n_{\text{AT\_HOME}} = 37$, $n_{\text{I-TAU}} = 95$; $\Delta_{\text{AT\_HOME—I-TAU}} = 0.05$, $d = 0.01$, 95% $CI = [-2.18, 2.28]$, $p = .96$). Similarly, there was no significant difference between conditions in the HoNOSCA-SR with patients in AT_HOME having an average value of 12.86 and patients in I-TAU of 11.94 ($n_{\text{AT\_HOME}} = 23$, $n_{\text{I-TAU}} = 44$; $\Delta_{\text{AT\_HOME—I-TAU}} = 0.92$, $d = 0.11$, 95% $CI = [-2.78, 4.61]$, $p = .63$). Analyses on group differences remained non-significant even when not adjusting for treatment duration.

Treatment satisfaction

Considering all families treated in AT_HOME ($n = 37$), 30 parents or pairs of parents (81%) completed the questionnaire on treatment satisfaction as well as did 21 out of the 31

Table 4 Satisfaction of patients with different treatment aspects

Satisfaction with…	AT_HOME			I-TAU			Test statistics
	Items	n[a]	*Mean*[b] ± *SD*	Items	n[a]	*Mean*[b] ± *SD*	
Initiation phase	1	21	3.90 ± 1.18	2	37	4.22 ± 0.67	$t_{56} = -1.34$, $p = .19$
Information and transparency	7	20	4.20 ± 0.64	7	37	4.00 ± 0.69	$t_{55} = 1.09$, $p = .28$
Treatment phase	4	20	3.91 ± 0.64	6	34	4.02 ± 0.79	$t_{52} = -0.56$, $p = .58$
Team	9	21	4.43 ± 0.56	9	36	4.30 ± 0.75	$t_{55} = 0.71$, $p = .48$
Completion phase	3	21	3.93 ± 0.89	3	37	4.01 ± 1.08	$t_{56} = -0.31$, $p = .76$
Treatment benefit	5	21	3.82 ± 0.99	5	33	4.07 ± 1.07	$t_{52} = -0.85$, $p = .40$

[a]Cases without missing

[b]Scale from 1 = "not at all satisfied" to 5 = "absolutely satisfied"

Table 5 Satisfaction of parents with different treatment aspects

Satisfaction with…	AT_HOME			I-TAU			Test statistics
	Items	n[a]	*Mean*[b] ± *SD*	Items	n[a]	*Mean*[b] ± *SD*	
Initiation phase	2	28	4.66 ± 0.50	3	54	4.42 ± 0.58	$t_{80} = -1.88$, $p = .06$
Information and transparency	8	29	4.42 ± 0.67	9	55	4.39 ± 0.66	$t_{82} = 0.23$, $p = .82$
Treatment phase	5	28	4.33 ± 0.63	6	55	4.29 ± 0.65	$t_{81} = -0.31$, $p = .75$
Team	6	29	4.76 ± 0.48	6	56	4.66 ± 0.52	$t_{83} = 0.84$, $p = .40$
Completion phase	2	28	4.38 ± 0.76	2	56	4.13 ± 1.03	$t_{82} = 1.10$, $p = .28$
Treatment benefit	7	26	4.20 ± 0.63	7	54	4.13 ± 0.75	$t_{78} = 0.37$, $p = .71$

[a]Cases without missing

[b]Scale from 1 = "not at all satisfied" to 5 = "absolutely satisfied"

patients aged 12 or older (68%). In the I-TAU group ($n = 96$), 57 parents or pairs of parents (59%) completed the questionnaire as well as did 37 out of the 74 patients aged 12 or older (50%). The response rate was significantly higher in the AT_HOME group for both the parent questionnaire ($\chi^2_{1,\, n\,=\,133} = 5.56$, $p = .02$) and the patient questionnaire ($\chi^2_{1,\, n\,=\,105} = 7.27$, $p < .01$). The average responses on satisfaction with different aspects of treatment are depicted in Table 4 for patients and in Table 5 for the parents. No significant differences occurred when comparing AT_HOME and the I-TAU group.

Discussion

This study investigated the treatment outcomes of AT_HOME as a potential and equally effective alternative to inpatient treatment for children and adolescents with acute mental disorders. Using the HoNOSCA and HoNOSCA-SR as indicator of psychopathology burden, we found significant post-treatment improvement in patients treated in AT_HOME with moderate to large effect sizes. Within a non-randomized design, we found no differences in treatment effects between AT_HOME and an I-TAU control group.

Although assignment to treatment in the current study was non-randomized, the two groups did not differ in their demographic characteristics; there were no differences in the distribution of age or gender. However, distribution of primary diagnoses across the two groups differed: in AT_HOME there was a higher proportion of F4 codes (neurotic, stress-related, and somatoform disorders), and patients in I-TAU had higher proportions of F3 and F8 codes (affective disorders and disorders of psychological development; diagnoses according to ICD-10) [27]. These differences probably result from the non-randomized sampling method. Since patients and their families were free to choose whether or not to participate in AT_HOME, patients with anxiety disorders may have preferred to stay at home for therapy rather than go to the hospital. In contrast, families of patients with affective disorders, such as major depression, possibly hoped for an activating effect from the daily structure provided on the inpatient unit and felt overwhelmed with the idea of structuring daily life in the home environment. Also, fear of suicidal acts is common in families of patients with affective disorders, so they may have preferred inpatient treatment for around-the-clock supervision. In comparison to previous HT studies [11, 14, 16, 28], our sample showed reduced rates of externalizing disorders. This may be due to the fact that some of the previous HT studies—i.e., trials with MST—have focused on the treatment of conduct disorders [28, 29] or have defined certain diagnoses as exclusion criteria for HT [30]. This resulted in higher rates of externalizing disorders in contrast to our sample, in which no diagnoses were excluded. Compared to studies that included all diagnoses, the proportion of externalizing diagnoses is more similar [11, 13, 31], though still slightly lower in AT_HOME. This seems plausible, considering the age distribution in the AT_HOME sample was skewed toward older age; only 6 patients (16%) were 11 years or younger. In this age group, F9 codes of the ICD-10 (behavioral and emotional disorders with onset usually occurring in childhood and adolescence) are more common than in older patients. As F9 codes make up a large proportion of the externalizing disorders, this category is underrepresented in our sample. In addition, mood disorders (F3) were slightly underrepresented and anxiety disorders (F4) were overrepresented, compared with other HT studies. This should be taken into account when comparing our findings with those of other HT studies, as patients with different disorders may respond differently to HT [30, 32, 33].

Patients in the two treatment groups differed significantly with respect to their levels of psychosocial functioning at baseline, with decreased functioning in AT_HOME patients. This difference was not expected, as both conditions were tailored to the same group of patients. However, the finding suggests that the AT_HOME sample consisted of patients who were not less impaired in their functioning than those treated in inpatient wards. This is an important aspect, because it contradicts the concern that AT_HOME might "snatch away" less impaired patients from the inpatient units.

In general, clinicians (HoNOSCA) and patients (HoNOSCA-SR) had little agreement ($r = 0.19$, n.s.) in their appraisal of the level of psychopathological burden, as reflected in the mean group differences: although patients did not differ between groups at treatment admission in terms of clinician-rated psychopathological burden (HoNOSCA), patients' self-rating of HoNOSCA-SR differed significantly between groups. Patients in the AT_HOME group rated their psychopathological burden as less severe than patients in the I-TAU group and as less severe than the respective clinician. The discrepancy between HoNOSCA and HoNOSCA-SR in the HT group could be a methodological artifact, as the HoNOSCA-SR was completed only by patients aged 12 years or older, whereas the HoNOSCA was assessed for all patients regardless of age. One might assume interaction effects in which the older patients were generally less impaired if they could stay at home and the younger patients were the more impaired. However, reanalysis of the HoNOSCA and GAF, which included only patients aged 12 years and older, did not change the results. Maybe patients who were more withdrawn (i.e., with anxiety disorders) received lower ratings of psychosocial functioning and higher ratings of psychopathology on the external assessment but did not feel, or rate themselves, so impaired when given the opportunity to remain at home in their familiar

environment and "safe base". A further explanation is a possible selection bias: patients who subjectively felt less ill were perhaps more confident in seeking treatment in their own home environment and therefore primarily chose this setting. In addition, timing of the assessment should be considered, which was immediately after admission. While patients in AT_HOME experienced relatively little change in their daily routines due to the start of therapy, patients referred to a hospital ward entered a completely different setting. They moved into a new environment with regard to housing, peers, and school. Patients who were asked how they were doing at that moment felt probably more insecure and impaired than patients in AT_HOME who did not experience these changes.

The unadjusted effect sizes of symptom reduction in AT_HOME found in the present study are comparable to previous studies that used HT as a full replacement for inpatient treatment [14, 29]; however, studies using HT as an supplement to inpatient treatment found slightly higher effect sizes that are comparable to those of our I-TAU [11, 13]. During inpatient treatment, children and adolescents are temporarily removed from their often problematic environment and relieved of the stress potentially associated with the family or school setting. This temporary relief might be one reason why in the present study the I-TAU condition led to a slightly higher reduction in psychopathology burden than AT_HOME, when descriptively compared.

However, the unadjusted treatment effect of the two treatment conditions cannot be directly compared because allocation to the groups was non-randomized and systematic group differences occurred at baseline, as observed for the HoNOSCA-SR. We employed AIPW-analyses to account for these differences and to control for treatment duration. We chose the inverse probability method because there was insufficient overlap between the two groups for propensity score matching, too few data were available for stratification, and AIPW better resemble an RCT compared with regression-adjustment of baseline data alone. Calculation of the adjusted treatment effect using AIPW models yielded a null effect for differences between the AT_HOME and I-TAU groups on clinician-rated and self-rated psychopathological burden, although the unadjusted effect sizes differed. These results are consistent with previous studies that found no differences in treatment outcomes for HT compared with an I-TAU control group [11, 15, 16, 34]. There is evidence in the literature that treatment effects achieved with HT may remain more stable than those achieved with I-TAU [12, 14]. Improvements achieved during HT are directly incorporated into the patient's daily life, which prevents the risk of failed transfer after discharge. To evaluate the stability of the treatment effect achieved, a follow-up of the present sample seems critical for the future.

One should keep in mind that patients and their families in AT_HOME had to make an active choice to receive HT, unlike most patients in the control group, who did not meet the inclusion criteria and therefore could not choose which treatment they wanted. As the expectation towards treatment may have influenced treatment choice, participants in AT_HOME may have had more positive expectations towards the upcoming treatment. Positive treatment expectation in turn has been shown in previous studies to increase patient and parent adherence to treatment, leading to better treatment outcomes and higher patient satisfaction [35–37]. It is, therefore, possible that treatment effects and satisfaction in the HT group were slightly overestimated compared with the I-TAU group.

Treatment satisfaction among patients and families in AT_HOME was generally high. For example, 71% of patients and 85% of parents indicated to rather agree or to agree completely with the statement "*Overall, I am satisfied with the treatment*", while no one disagreed. With the statement "*I would recommend the treatment to others*", 85% of patients and 87% of parents indicated to rather agree or to agree completely, while 5% of patients and parents agreed rather not or not at all. On average, patients showed slightly lower satisfaction than parents, which is consistent with results of previous studies on HT among children and adolescents [16, 38, 39]. Comparing the satisfaction data of patients treated in AT_HOME with those in the I-TAU group revealed no relevant differences, indicating comparable subjective benefits of patients in both groups. Response rates for the questionnaire on treatment satisfaction were significantly higher in the AT_HOME group than in the I-TAU group. Similar patterns in the response rate of satisfaction questionnaires have been reported previously [39] and might reflect a higher adherence to clinical guidelines by the treatment team in the new treatment condition, which more actively encouraged patients to respond to the satisfaction questionnaire. Another possibility is response bias, as treatment satisfaction has been shown to correlate with response rate [40], possibly overestimating treatment satisfaction in both groups, with greater overestimation in the I-TAU group.

An interesting aspect concerns the application of HT in pandemic situations. A large body of literature has investigated the impact of the March 2020 COVID-19 pandemic outbreak on young people and their families [e.g., 41]. As summarized by UNICEF in a recent report, school closures, home office, and the loss of social networks resulted in considerable distress for many families at home and a significant increase in mental illness among young people, warranting special support [42]. At the same time, many mental health services had been closed due to quarantine regulations. The AT_HOME project was designed and implemented before the COVID-19 pandemic outbreak in March 2020, and most

of the data presented in this article were collected before this time. Therefore, no direct conclusions can be drawn about the adequacy of HT in the context of a pandemic. However, we suggest that HT could offer an important component in supporting both young patients with mental health issues and their family systems during the pandemic, as problems arising from the new situation can be directly observed and addressed in the respective environment. Also, patients in HT can be treated independently of other patients. A positive COVID-19 test may imply the quarantine of an entire inpatient unit, which is not the case in HT, where the team can continue to visit the remaining patients.

Limitations and strengths

The current study has some limitations. First, finding no differences between the two conditions does not automatically preclude the absence of real differences [43]. The current analyses were robust against false positive results but do not ensure against false negative results. We performed sensitivity power analyses, which showed that we could expect to find medium group differences of $d = 0.54$ with high statistical power of $1 - \beta = 0.8$ based on the present sample size. It is possible that small differences exist between the two conditions that could not be detected due to the limited sample size. However, this seems rather unlikely because all effects found for differences between groups were minimal. The current data provide no evidence to reject the hypothesis that the two interventions have the same effect.

Second, we had limited data restricted to the assessment procedure prescribed by the mandatory Swiss ANQ initiative [44] which defines the clinical routine. HoNOSCA and GAF were not rated by independent researchers but by clinical staff who were not blinded to treatment condition. However, we expect no systematic bias between the groups due to the lack of blinding. In both groups, therapists rated treatment outcome for their own patients which may at least have led to comparable bias in the two groups. Also, using information from different sources with clinician-rated assessments and self-rated assessments of the HoNOSCA(-SR) provides a more comprehensive picture of the actual situation regarding psychopathological burden. GAF data were available only for admission and thus could not be used for the evaluation of the treatment trajectory. HoNOSCA(-SR) data were available only for admission and discharge and do not allow statements about long-term outcomes. In future, follow-up assessments would be important to evaluate the stability of treatment effects.

Third, this was a non-randomized study-design with allocation by choice. Systematic differences between the two treatment groups might have occurred, which limits the external validity of the results. For example, it is likely that patients with anxiety disorders generally prefer HT to treatment in the clinic, resulting in an overrepresentation of these patients in the AT_HOME group. Another consequence of the non-randomized design was the uneven distribution of patient numbers in the two groups. The I-TAU group pooled patients from five different inpatient units of the CAP and therefore was considerably larger than the HT group, which was composed only of patients from the AT_HOME program. However, the analyses revealed that the two treatment samples were similar in terms of their demographics and most baseline data. Further evaluation with randomized assignment to treatment condition would be desirable to support the current findings and increase their external validity.

A particular strength of the present study is the stringent operationalization of HT as a full replacement for inpatient treatment. This allows us to draw a clear conclusion concerning the efficacy of the HT program, in contrast to most previous studies that used HT as a supplement to inpatient treatment, which makes it difficult to disentangle the treatment effect of HT from the supplemented inpatient treatment.

The recruitment process followed a rigorous procedure. Participation in AT_HOME was only offered to patients referred to the CAP for inpatient treatment, which ensured that only patients who would have been treated in a clinical inpatient ward were included. At the same time, there were virtually no exclusion criteria for clinical diagnoses that could be treated in AT_HOME, resulting in the inclusion of general psychiatric patients with different diagnoses and inpatient treatment needs, which strengthens the external validity of our results. Though relatively small, the composition of the current sample may provide an indication of which patient groups are more likely to choose HT after standard clinical implementation of the HT program, when patients are free to choose their preferred treatment setting.

Conclusion and implications

With the present study, we aimed to investigate the clinical outcome of a new inpatient-replacing HT for children and adolescents with acute mental disorders. We found a significant reduction in psychopathological burden in patients treated in AT_HOME with no differences in the average treatment effect between the AT_HOME group and an I-TAU control group. These initial results suggest that AT_HOME may be an effective alternative for children and adolescents with acute mental health disorders who would have previously been treated as inpatients. Further research with larger sample sizes and random group assignment should attempt to replicate and extend the current findings. Subgroup-analyses are needed to determine whether there

exist certain clusters of patients who benefit more from AT_HOME than others. Future follow-up assessments of the present sample are needed to evaluate the stability of the treatment effects achieved. In the long run, the program could be integrated into the routine health care system in Switzerland as a possible alternative to inpatient treatment, thus driving the shift from treatment in the clinic to treatment AT_HOME.

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Author contributions M.K.: conceptualization, funding acquisition, project administration, resources, supervision, and writing—review and editing. D.G.: formal analysis and writing—original draft. S.L.: methodology, software, supervision, and writing—review and editing. U.B.: investigation and writing—review and editing. C.R., Jo.K. and Ju.K.: supervision and writing—review and editing.

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Data availability Not applicable.

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Declarations

Conflict of interest All authors declare that they have no financial or non-financial interests or potential conflicts of interest.

Ethical approval The retrospective use of routine clinical data used for research purposes was approved by the respective institutional review board (Cantonal Ethics Committee for Research of the Canton of Bern; BASEC number: REQ-2020–00546).

Consent to participate Not applicable due to usage of data derived from a regular quality assurance process which included routinely collected clinical data. The procedure was approved by the respective institutional review board (BASEC number: REQ-2020–00546).

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Appendix C

Comparison of the long-term outcome of home vs. inpatient treatment: 18-24 months follow-up of a non-randomized controlled trial

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Abstract

Home Treatment (HT) in child and adolescent psychiatry is an increasingly important topic in the current context of global crises and strained mental health systems. We implemented a HT program provided by a multiprofessional treatment team and compared long-term outcomes of 27 patients (48% female, Ø15.15 ± 2.77 years) who received HT with those of 48 patients (69% female, Ø16.35 ± 2.87 years) who received inpatient treatment as usual (I-TAU). Psychopathology was assessed using the Health of the Nation Outcome Scale for Children and Adolescents (HoNOSCA[-SR]) and psychosocial functioning was assessed using the Global Assessment of Functioning (GAF) at admission, discharge, and 18-24 months after discharge. Treatment outcomes were analyzed using mixed models. The results showed that patients in the HT arm had significantly lower HoNOSCA scores at follow-up (β = -4.25 [95%CI: -7.64 to -0.86], *SE* = 1.73, p = 0.014) and higher GAF scores (β = 12.09 [95%CI: 4.48 to 19.70], *SE* = 3.88, p = 0.002) compared to those in the I-TAU arm. No significant differences were observed in HoNOSCA-SR scores (β = -2.46 [95%CI: -9.16 to 4.30], *SE* = 3.43, p = 0.48) and readmission rates (OR = 1.23 [95%CI = 0.47 to 3.20], p = 0.67). These results highlight the potential of HT in improving long-term functional and psychopathological outcomes in youth mental health. HT may be an equally effective and even more sustainable type of treatment for child and adolescent mental disorders. The trial was preregistered at the German Clinical Trials Register (DRKS00025424, 05/27/2021).

Key words: home treatment, therapy setting, child and adolescent psychiatry, psychotherapy research

1 Introduction

Most mental disorders have their onset in childhood or adolescence [1, 2], with global point prevalence estimates approaching 14% [3]. The onset of the global COVID-19 pandemic in early 2020 posed additional strain on young people's mental health [4]. In particular, increases in the prevalence of affective and anxiety disorders [5, 6] and in self-harm and eating disorders [7] have been reported. The increased need for professional mental health care led to prolonged boarding time before inpatient admission [8]. Although the impact of the pandemic on youth mental health is complex and not fully understood, most studies are consistent in highlighting the critical need for effective treatments to meet the challenge of overburdened mental health care systems [9]. Concurrently, many children and adolescents still report relatively high barriers to seeking help, especially those with clinical depressive symptoms [10], with stigma and family barriers being the main perceived barriers.

Home treatment (HT) in child and adolescent psychiatry as an alternative to inpatient treatment as usual (I-TAU) is a promising approach to address these challenges as it can be rapidly implemented and scaled, without the extensive infrastructure required by hospital settings [11, 12]. The close involvement of the family throughout the treatment may help addressing family-related barriers, and bringing the psychiatry to the patient may help to reduce stigma compared with bringing the patient to the psychiatry [13]. In contrast to inpatient treatment, the young patients remain in their home environment during HT and receive frequent and regular visits from a multidisciplinary team including child and adolescent psychiatrists and psychotherapists, social workers, and nursing staff [14]. The patient's family, school, and broader social environment (e.g., peers) can be involved closely in therapy, allowing to observe and address problems as they arise, thus holding the potential to increase the stability of treatment effects and reduce readmission rates [15].

Over the past four decades, only little research in child and adolescent populations has been conducted worldwide; however, providing first and limited empirical support for a non-

inferiority of HT compared to I-TAU [16]. In 2019, the University Hospital of Child and Adolescent Psychiatry and Psychotherapy (CAP) Bern (Switzerland) implemented a new HT program named "AT_HOME" as an alternative to conventional inpatient treatment, and found this to be comparably effective in reducing psychopathology during treatment when compared with I-TAU [17]. The current follow-up of this initial pilot study aimed to evaluate the long-term stability of clinical outcomes and readmission rates of HT in AT_HOME and compare them with I-TAU.

2 Methods

This original study was a monocentric, non-randomized controlled trial with two arms. Clinical data was obtained at admission and discharge within an established quality assurance process, and were previously published elsewhere [17]. Additional follow-up outcomes were assessed through clinical interviews between 18 and 24 months after discharge. Ethical approval was obtained from the Cantonal Ethics Committee of Bern for the retrospective use of anonymized medical records (BASEC number: REQ-2020–00546) and for the prospective follow-up study (2021-00098). The follow-up of the trial was preregistered at the "German Clinical Trials Register" (DRKS00025424, 05/27/2021).

Population

A total of 133 children and adolescents with acute mental health disorders were admitted to the CAP Bern from May 1, 2019, to July 20, 2020. Of these, 96 received I-TAU, and 37 received HT in the new inpatient-equivalent HT program (AT_HOME). Eligibility for AT_HOME required a stable residence within a 30-minutes radius of the CAP Bern. Exclusion criteria were the presence of acute child welfare hazards in the patient's home or acute endangerment to self or others that required immediate protection. Families that met eligibility criteria could choose

between HT in AT_HOME or I-TAU (non-randomized). 18 months after discharge from this treatment, all participants were contacted and invited to participate in the follow-up assessment.

Treatment

The AT_HOME program offered intensive, inpatient-equivalent treatment at the patient's home or other relevant locations, like schools, and was designed to completely replace an inpatient stay. Patients received daily visits (60-120 minutes) by a treatment team member, supplemented by phone calls (and visits if needed) on weekends, and a 24/7 crisis management hotline. In cases of acute suicidal crises, immediate hospitalization was available, with the HT team continuing care for up to three days. Key features of the HT included a multi-professional treatment team, the close involvement and empowerment of family, peers, and relevant others in the treatment, and maintenance of normal life routines such as school visits. Treatment duration was limited to 3-4 months.

I-TAU was delivered in one of the CAP's five inpatient units. Patients resided in the unit, participated in individual and group therapies, and attended clinic school, with no fixed duration.

Outcomes & instruments

Psychopathology was assessed at admission, discharge and follow-up for all patients by clinician ratings using the Health of the Nation Outcome Scale for Children and Adolescents [HoNOSCA, 18] and for adolescents aged 12 and above by self-rating [HoNOSCA-SR, 20]. Psychosocial functioning was assessed at admission and at follow-up only using the Global Assessment of Functioning Scale [GAF, 21, 22]). Additional outcomes at follow-up included treatment satisfaction [ZUF-8, 23] and the use of subsequent mental health services in the follow-up period collected by the "Mannheim resource module" [MRV, 19, 24]. Assessments were carried out by unblinded clinical raters at admission and discharge and via telephone by

trained researchers at follow-up. Follow-up assessments were recorded and rerated by a second, blinded rater, and the mean of both ratings was used for all analyses. For discrepancies of more than 1 category in the HoNOSCA or alternative more than 10 points on the GAF, consent was sought under supervision of an independent third senior clinician. Interrater reliability (before consent was sought) was high for HoNOSCA ratings ($\kappa = .77$) and very high for GAF ratings (ICC = .95).

Analysis

Due to the retrospective nature of the original study design, we performed no a-priori power analyses. HoNOSCA(-SR) and GAF scores were analyzed using linear mixed models with a random intercept to group observations by subject, accounting for individual variability. The models considered the main effects of the treatment group (HT vs. I-TAU) and time points (admission, discharge, follow-up), as well as their interactions. Group by time interactions were followed by contrasts, using the Wald test, to test the hypothesized advantages of HT in achieving higher stability of the treatment effects in the HoNOSCA(-SR) and GAF at follow-up. Control variables included sex, age at study entry, and treatment duration. Post-discharge treatments were considered, including subsequent inpatient (including day clinic) and outpatient treatments, as well as medication. Interaction terms were calculated between time points and group, sex, age, and treatment duration. Due to the lack of randomization in group assignment, we implemented inverse probability weighting (IPW) [25, 26] to balance pre-treatment characteristics. Sensitivity analyses were conducted for all mixed models including only blinded second rater scores. Group differences in demographic variables were analyzed using two-tailed t-tests and Fisher's exact tests. Missing data in the HoNOSCA were imputed using the mean of the remaining 13-*k* completed items, while only complete data records were considered for the GAF analyses. All analyses were performed using stata v17.0.

3 Results

Nine patients who were admitted more than once during the study period were included only once, in the category of their first admission. Of the 34 patients eligible in the HT arm, 27 (79.4%) consented to participate in the follow-up assessment. Of the 90 patients eligible in the I-TAU arm, 48 (53.3%) participated. Detailed demographic and clinical sample characteristics are presented in Table 1.

Table 1 Sample characteristics at follow-up

	HT (*n*=27)	**I-TAU (*n*=48)**	**total (*n*=75)**	**test statistics**
Females, *n* (%)	13 (48%)	33 (69%)	46 (61%)	$\chi^2(1, N=75)=3.09$, $p=0.079$
School status (in school or employed), *n* (%)	24 (88.89%)	40 (83.33%)	64 (85.33%)	$\chi^2(1, N=75)=0.43$, $p=0.51$
Age (in years), *M* ± *SD*	15.15 ± 2.77	16.35 ± 2.87	15.92 ± 2.87	$t(73)=1.77$, $p=0.081$
Treatment duration (in days), *M* ± *SD*	84.59 ± 29.24	91.81 ± 58.74	89.21 ± 50.04	$t(73)=0.60$, $p=0.55$
Latency until follow-up (in months), *M* ± *SD*	21.33 ± 1.33	21.35 ± 2.79	21.35 ± 2.36	$t(73)=0.04$, $p=0.97$
Principal diagnoses at admission; *n* (%)				$\chi^2(1, N=75)=18.34$, $p=0.005$
F1	0	1 (2.08%)	1 (1.33%)	
F2	0	3 (6.25%)	3 (4.00%)	
F3	4 (14.81%)	16 (33.33%)	20 (26.67%)	
F4	15 (55.56%)	8 (16.67%)	23 (30.67%)	
F6	0	5 (10.42%)	5 (6.67%)	
F8	2 (7.41%)	9 (18.75%)	11 (14.67%)	
F9	6 (22.22%)	6 (12.50%)	12 (16.00%)	

Note. HT=Home Treatment, I-TAU=Inpatient Treatment as Usual, M=Mean, SD=Standard Deviation; principal diagnoses according to ICD-10

Treatment outcome

Post-hoc contrasts of the group by time interactions, controlling for baseline differences and covariates, were significant for the HoNOSCA with lower scores in the HT group at follow-up (β = -4.25 [95%CI: -7.64 to -0.86], *SE* = 1.73, p = 0.014) and for the GAF with higher scores in the HT group at follow-up (β = 12.09 [95%CI: 4.48 to 19.70], *SE* = 3.88, p = 0.002), but not for the HoNOSCA-SR (β = -2.46, [95%CI: -9.16 to 4.30], *SE* = 3.43, p = 0.48). Fig. 1 illustrates the model predictive values of the outcome trajectories for both groups over time. Sensitivity analyses considering the blinded second ratings did not change the results. Raw data scores and detailed results of the three mixed models are presented in the Supplementary Information, Tables S1 – S4.

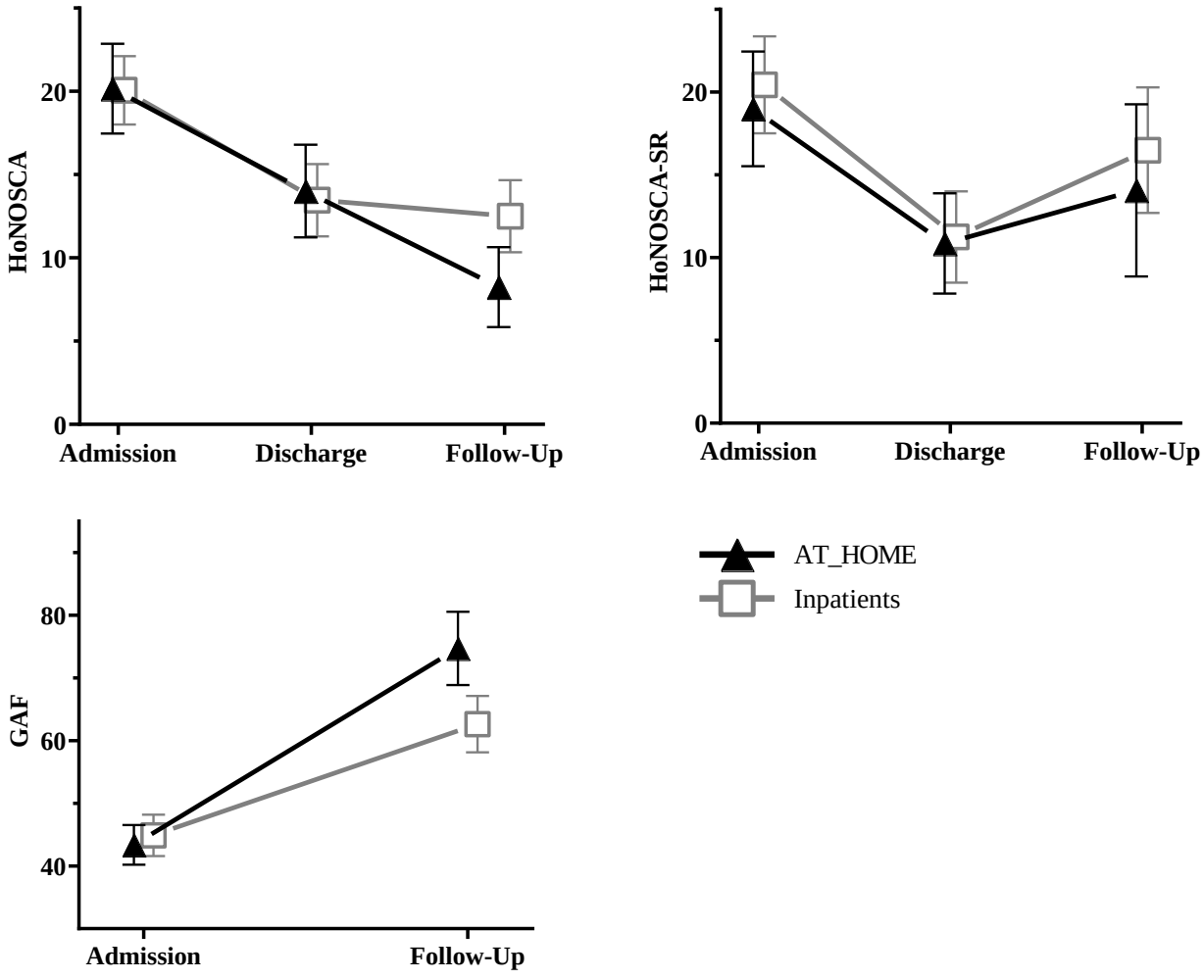

Fig. 1 Model predictive values (Mean ± 95% confidence interval) of the trajectory of the primary outcomes in the two groups over time

Treatment after discharge

Utilization of subsequent care after discharge from the index treatment is presented in Table 2. Patients in the two arms did not differ in terms of the mean number of readmissions and the mean number of days in subsequent inpatient or day clinic care. There was no difference in the mean number of outpatient contacts, either. Medication use after discharge was reported by 26 (96.3%) patients in the HT arm and 39 (81.3%) patients in the I-TAU arm (Fisher's exact test, $p = 0.084$).

Table 2 Subsequent care after discharge from the index treatment

	HT		I-TAU		Test statistics
	M	***SD***	***M***	***SD***	
Readmissions	0.81	0.79	1.00	1.09	OR=1.23 [95%CI=0.47 to 3.20], p=0.67
Inpatient / day clinic days	75.04	99.23	55.15	92.63	$t(73)$=-0.87, p=0.39
Outpatient contacts	81.85	60.71	109.92	77.91	$t(73)$=-1.61, p=0.11

Note. CI = Confidence Interval, HT=Home Treatment, I-TAU=Inpatient Treatment as Usual, M=Mean, OR=Odds Ratio, SD=Standard Deviation

Treatment satisfaction

The mean satisfaction of parents in the HT arm was $M = 16.86 \pm 5.01$ ($n = 22$) and in the I-TAU arm $M = 15.92 \pm 6.08$ ($n = 37$), with no significant differences between groups ($t(57) = -0.62$, $p = 0.54$). The average satisfaction of patients in the HT arm was $M = 16.17 \pm 5.18$ ($n = 24$) and in the I-TAU arm $M = 13.14 \pm 5.77$ ($n = 42$), with significantly higher ratings in the HT arm ($t(64) = -2.12$, $p = 0.038$).

4 Discussion

In this follow-up study of a trial comparing the effectiveness of HT and I-TAU for children and adolescents with psychiatric disorders, we found that patients treated with HT had significantly better outcomes in clinician-rated psychopathology and psychosocial functioning compared to those treated with I-TAU one year and a half after discharge. As reported previously [15], these results suggest that HT is particularly effective in the long-term as it facilitates the transfer of achievements during therapy after discharge due to the strong involvement of the family and the opportunity to address problems and their solutions in vivo during treatment [27, 28]. However, no significant differences were observed in self-rated psychopathology, which diverged from clinician-rated outcomes. Following initial reductions of HoNOSCA-SR scores during treatment, adolescents reported higher levels of psychopathology at follow-up compared to discharge, highlighting the challenges of transitioning from a supportive treatment environment to everyday life. This period was further complicated by the coinciding global COVID-19 pandemic, which included school closures and increased family tensions due to lockdown measures. These factors have been repeatedly linked to negative consequences on the mental health of young people in national and international studies [3, 5, 6, 29, 30]. In fact, the HoNOSCA self-ratings at follow-up in the present study were similar to scores in non-clinical populations during the pandemic [31], indicating a general increase in psychological strain that was not seen in pre-pandemic samples [20, 32]. As previous studies have shown low agreement between clinician and patient ratings, and that adolescents were less sensitive to the change during a treatment [20, 33], this could partially explain the discrepancy between the two ratings in the current study.

Overall readmission rate was high during the one and a half years between discharge and follow-up, emphasizing the general importance of follow-up psychiatric services after inpatient discharge. No significant differences in readmission rates were found between the two treatment arms for subsequent inpatient, outpatient, and pharmacological treatment in the

follow-up period. These findings are consistent with previous findings [13, 34, 35] but contrary to the expectation that higher clinical improvements in the HT arm would be reflected in a lower readmission rate. Again, the potential impact of the COVID-19 pandemic should be noted, which may have led to an overestimation of post-discharge mental health service usage in our study. Furthermore, there is evidence that adolescents with pre-existing mental health conditions may have been particularly affected during this event [36], which could have masked lower needs for subsequent psychiatric treatment after discharge in either of the treatment groups.

Acceptance of the new treatment was generally high. Parents in the HT arm reported comparable retrospective treatment satisfaction to parents in the I-TAU arm. Contrary to previous HT trials [37], patients who received HT reported higher retrospective treatment satisfaction compared to those in the I-TAU arm. This may reflect their better psychological condition at follow-up as a result of the treatment they received. Additionally, HT allowed children and adolescents (many with anxiety disorders) to avoid transfer to a psychiatric hospital, which is a stressful event for these young patients and is often perceived as stigmatizing [13, 38], which may have contributed to this higher satisfaction. Future research, including qualitative questions, could elucidate the specific advantages and disadvantages perceived by patients and thus help identify ways to improve the treatment experience.

These findings should be viewed in the context of several limitations. First, the non-randomized, choice-based allocation may have resulted in systematic differences between groups, such as an overrepresentation of patients with anxiety disorders as observed in the HT arm [17]. However, a recent meta-analysis and meta-regression on the comparison between HT and I-TAU [16] revealed that HT seems to be more superior within randomized controlled trials, which suggests that our findings may reflect true group differences rather than selection effects. Second, while almost 80% of eligible HT patients consented to participate, only 53% of eligible I-TAU patients did so, possibly introducing non-response bias [39, 40]. Third, the outcome

measures available were limited to the assessment procedure prescribed by the Swiss ANQ initiative [41] and were rated at baseline and discharge by clinical staff who were not blinded to the treatment condition. In addition, assessment of post-discharge service usage relied on self-reported data, which is subject to recall bias. Further research with larger and balanced samples is needed to replicate these findings and evaluate the cost-effectiveness of HT versus I-TAU.

Conclusion

Patients who received HT in the AT_HOME pilot treatment had significantly lower clinician-rated psychopathology and higher psychosocial functioning compared to patients who received I-TAU, one and a half years after discharge. These findings suggest that HT is particularly effective in the long-term and emphasize the importance of considering both short- and long-term outcomes of psychiatric treatments. Taken together, the study suggests that HT holds the potential for higher stability of treatment effects and could be one element to address the challenges faced by strained mental health systems in child and adolescent psychiatry, although open questions remain, and further research is needed.

Declarations

Competing Interests

All authors declare that they have no potential or actual conflict of interest. No funding was received for conducting this study.

Ethics approval

Ethical approval was obtained from the Cantonal Ethics Committee of Bern for the retrospective use of anonymized medical records (BASEC number: REQ-2020–00546) and for

the prospective follow-up study (2021-00098). The follow-up of the trial was preregistered at the "German Clinical Trials Register" (DRKS00025424). The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Data Availability Statement

The data will be made available by the corresponding author upon reasonable request. The data are not publicly available due to privacy restrictions.

Authors' Contributions

MK and DG conceptualized the study. SL and DG designed the methodology and did the data analyses. DG prepared the original draft of the manuscript and Fig. 1 with the input of UB and CR and with supervision of MK. All authors read, edited, and approved the final manuscript and had responsibility for the decision to submit for publication.

Supplementary Information

The supplementary document "Supplementary Information.pdf" presents the raw data scores of the clinical outcomes and the detailed results of the three mixed models are (Tables S1 – S4), as well as the CONSORT 2010 checklist of information to include when reporting a pilot trial.

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Supplementary Information

Graf, Lerch, Boehnke, Reichl, Kaess. Comparison of the Long-Term Outcome of Home vs. Inpatient Treatment: 18-24 Months Follow-Up of a Non-Randomized Controlled Trial

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Table S1. Raw scores of clinical outcomes

	Home Treatment			Inpatient Treatment As Usual		
	n	*M*	*SD*	*n*	*M*	*SD*
HoNOSCA						
Admission	27	19.64	6.97	47	20.38	6.93
Discharge	27	14.13	7.26	47	13.72	6.97
Follow-Up	27	9.05	6.81	48	12.60	8.51
HoNOSCA-SR						
Admission	17	13.12	8.34	30	24.20	9.55
Discharge	17	9.29	7.33	28	12.32	9.29
Follow-Up	24	12.08	11.26	42	15.95	11.25
GAF						
Admission	27	43.04	8.15	41	45.93	12.12
Follow-Up	27	71.54	16.59	48	63.67	17.82

Note. GAF = Global Assessment of Functioning Scale, HoNOSCA(-SR) = Health of the Nation Outcome Scale for Children and Adolescents (Self-Rating), *M* = Mean, *SD* = Standard Deviation

Table S2. Mixed-effects regression of the HoNOSCA outcome

HoNOSCA	Coef.	*SE*	*z*	[95% Conf	Interval]	*p*
Time						
Postline	-7.60	1.64	-4.65	-10.81	-4.40	<0.001
Follow-Up	-14.01	2.22	-6.31	-18.37	-9.66	<0.001
Group						
AT_HOME	0.10	1.72	0.06	-3.28	3.47	0.95
Interaction						
Post#AT_HOME	0.45	1.58	0.29	-2.65	3.56	0.78
FU#AT_HOME	-4.35	2.24	-1.94	-8.73	0.03	0.052
Sex (female)	-2.02	2.03	-0.99	-6.00	1.96	0.32
Interaction						
Post#female	2.03	1.64	1.24	-1.18	5.24	0.22
FU#female	4.05	2.36	1.72	-0.58	8.67	0.086
Age	-0.18	0.28	-0.63	-0.74	0.38	0.53
Interaction						
Post#age	0.10	0.28	0.34	-0.46	0.65	0.73
FU#age	0.05	0.36	0.14	-0.66	0.76	0.89
Treatment Duration	0.02	0.02	0.97	-0.02	0.05	0.33
Interaction						
Post#Treatment Duration	-0.06	0.02	-3.49	-0.09	-0.02	<0.001
FU#Treatment Duration	-0.08	0.02	-3.81	-0.13	-0.04	<0.001
Inpatient days in FU period	0.01	0.01	0.82	-0.01	0.03	0.41
Outpatient contacts in FU period	0.02	0.01	1.22	-0.01	0.04	0.22
Medication in FU period (yes/no)	2.80	1.64	1.71	-0.41	6.01	0.088
Constant	21.18	1.85	11.42	17.55	24.82	<0.001

Note. HoNOSCA = Health of the Nation Outcome Scale for Children and Adolescents, *SE* = Standard Error

Table S3. Mixed-effects regression of the HoNOSCA-SR outcome

HoNOSCA-SR	Coef.	*SE*	*z*	[95% Conf	Interval]	*p*
Time						
Postline	-6.19	2.58	-2.40	-11.25	-1.14	0.016
Follow-Up	-7.57	4.03	-1.88	-15.48	0.33	0.060
Group						
AT_HOME	-1.45	2.32	-0.63	-5.99	3.09	0.53
Interaction						
Post#AT_HOME	1.06	2.66	0.40	-4.15	6.26	0.69
FU#AT_HOME	-0.98	4.01	-0.24	-8.83	6.88	0.81
Sex (female)	6.05	2.32	2.61	1.50	10.60	0.009
Interaction						
Post#female	-0.94	2.82	-0.33	-6.47	4.60	0.74
FU#female	7.02	3.20	2.20	0.75	13.29	0.028
Age	2.75	0.74	3.74	1.31	4.19	<0.001
Interaction						
Post#age	-1.83	0.67	-2.75	-3.14	-0.53	0.006
FU#age	-2.37	0.91	-2.60	-4.15	-0.58	0.009
Treatment Duration	-0.01	0.03	-0.47	-0.07	0.05	0.64
Interaction						
Post#Treatment Duration	-0.06	0.03	-1.91	-0.11	0.01	0.056
FU#Treatment Duration	-0.10	0.05	-1.83	-0.21	0.01	0.067
Inpatient days in FU period	0.02	0.01	1.16	-0.01	0.04	0.25
Outpatient contacts in FU period	-0.02	0.03	-0.97	-0.07	0.03	0.33
Medication in FU period (yes/no)	3.91	4.37	0.90	-4.65	12.47	0.37
Constant	13.31	2.12	6.27	9.15	17.48	<0.001

Note. HoNOSCA-SR = Health of the Nation Outcome Scale for Children and Adolescents – Self-Rating, *SE* = Standard Error

Table S4. Mixed-effects regression of the GAF outcome

GAF	Coef.	SE	*z*	[95% Conf	Interval]	*p*
Time						
Follow-Up	38.25	4.85	7.89	28.74	47.75	<0.001
Group						
AT_HOME	-1.51	2.31	-0.66	-6.03	3.01	0.51
Interaction						
FU#AT_HOME	13.60	4.44	3.06	4.89	22.31	0.002
Sex						
Female	-2.50	2.73	-0.92	-7.84	2.84	0.36
Interaction						
FU#Female	-3.60	4.78	-0.75	-12.97	5.78	0.45
Age	-.89	0.39	-2.31	-1.65	-0.14	0.021
Interaction						
FU#Age	1.95	0.78	2.50	0.42	3.47	0.012
Treatment Duration	0.01	0.03	0.38	-0.04	0.06	0.70
Interaction						
FU#Treatment Duration	0.11	0.05	2.34	0.02	0.20	0.019
Inpatient days in FU period	-0.04	0.02	-1.57	-0.08	0.01	0.12
Outpatient contacts in FU period	-0.03	0.03	-1.11	-0.09	0.02	0.27
Medication in FU period (yes/no)	-15.11	3.77	-4.01	-22.50	-7.72	<0.001
Constant	46.20	2.62	17.64	41.07	51.33	<0.001

Note. GAF = Global Assessment of Functioning Scale, *SE* = Standard Error

Table S5. CONSORT 2010 checklist of information to include when reporting a pilot trial, adapted for non-randomized trials, referring to Lancaster and Thabane (2019)

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a non-randomised trial in the title	1
	1b	Structured summary of trial design, methods, results, and conclusions	2
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for non-randomised trial	3-4
	2b	Specific objectives or research questions for trial	4
Methods			
Trial design	3	Description of trial design (such as parallel, factorial)	4
Participants	4a	Eligibility criteria for participants	4-5
	4b	Settings and locations where the data were collected	4-5
	4c	How participants were identified and consented	4-5
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	5
Outcomes	6a	Completely defined prespecified assessments or measurements to address each trial objective specified in 2b, including how and when they were assessed	5-6
Sample size	7a	Rationale for numbers in the trial	6
	7b	When applicable, explanation of any interim analyses and stopping guidelines	Not applicable
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	No randomization
	8b	Type of randomisation(s); details of any restriction (such as blocking and block size)	
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	

	11b	If relevant, description of the similarity of interventions	
Statistical methods	12	Methods used to address each objective whether qualitative or quantitative	6-7
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were approached and/or assessed for eligibility, randomly assigned, received intended treatment, and were assessed for each objective	No randomization
	13b	For each group, losses and exclusions after randomisation, together with reasons	
Recruitment	14a	Dates defining the periods of recruitment and follow-up	7
	14b	Why the trial ended or was stopped	Not applicable
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	7
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be by randomised group	7
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	7-8
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	Not applicable
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	No adverse events
Discussion			
Limitations	20	Limitations, addressing sources of potential bias and remaining uncertainty about feasibility	10-11
Generalisability	21	Generalisability (applicability) of methods and findings to future definitive trial and other studies	10-11
Interpretation	22	Interpretation consistent with objectives and findings, balancing potential benefits and harms, and considering other relevant evidence	9-10
	22a	Implications for progression to future definitive trial, including any proposed amendments	11
Other information			
Registration	23	Registration number for trial and name of trial registry	4
Protocol	24	Where the trial protocol can be accessed, if available	No protocol
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	12
	26	Ethical approval or approval by research review committee, confirmed with reference number	4

Lancaster, G. A., & Thabane, L. (2019). Guidelines for reporting non-randomised pilot and feasibility studies. *Pilot Feasibility Stud, 5*, 114. doi: https://doi.org/10.1186/s40814-019-0499-1